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AMERICAN RAILWAY JOURNAL.

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Railways, City Transit, Highways, Bridges, Tunnels and Canals, Water-Works, Artesian Wells, Irrigation, Sewerage and Municipal, Electrical, Contracting, Proposals Open, Manufacturing and Technical.

A DRAINAGE TUNNEL, 5 miles long, is proposed, at Leadville, Col., to furnish access to large bodies of ore now out of the reach of economic pumping. The estimated cost is $750,000, and the time for execution is placed at 10 years. Messrs. John F. CAMPION, W. B. PAGE and C. T. CARNAHAM, all of Leadville, Col., are the originators of the enterprise. The tunnel would start at Malta, 4 miles below Leadville, and drain all the principal mines, striking the Maid of Erin mine 950 ft. below the present workings. Within the last 10 years it is said that $3,000,000 has been expended in draining only a small part of the territory that would come within the range of this tunnel.

THE NIAGARA FALLS POWER-TUNNEL, which was commenced on Oct. 4, 1890, is now in about the following state of progress, as given in the *Niagara Falls Gazette:*

		Total in each shaft Sept. 12.	Progress in week.	Total for Sept. 19.
Portal	open cut	170 ft.		
	tunnel	588 "	71 ft.	829 ft.
Shaft 1	West	154 "	39 "	193 "
	East	169 "	37 "	206 "
Shaft 2	West	432 "	63 "	495 "
	East	413 "	51 "	464 "
Total		1,926 ft.	261 ft.	2,187 ft.

When finished this section will be 6,530 ft. long, and it is estimated that the tunnel to the canal will be completed by the middle of February next. The contractors, Messrs. Rodgers & Clement, are pushing the work rapidly, as the above weekly progress on a 24-ft. timbered tunnel indicates.

AN EXAMINATION FOR THE POSITION OF DRAFTSMAN, at $1,800 per year, in the office of the Quartermaster-General, will be held at the rooms of the Civil Service Commission at Washington, D. C., commencing Oct. 20, 1891, at 9 A. M. Applicants are required to be architects, well versed in designing and making correct drawings of buildings; they must be able to write or dictate specifications rapidly, and understand methods of construction and cost of materials in different parts of the country. In other words, they ought to be educated men in the profession, able to take charge of the draftsman's branch of the office. Application blanks will be furnished by the Civil Service Commission on application. JOHN T. DOYLE, Secretary.

RATHITE is a new kind of rubber made by Waddington, Rath & Co., of Spring Bank Mills, Hyde, England. It is said to consist of pure rubber, with the usual proportion of sulphur for vulcanization, and silk fibre in a finely divided state. It is intended to give increased toughness and durability in rubber exposed to great crushing strains, such as is its use in car buffers, cycle wheels, &c.

IMMIGRATION for the month ending Aug. 31, 1891 is given as follows by the last U. S. Treasury Department bulletin:

Ports.	1891.	1890.	Eight m'ths ending Aug. 31, 1891.
Baltimore	2,956	2,241	33,426
Boston	3,238	2,305	22,784
New Orleans	12	9	1,440
New York	36,711	30,363	335,998
Philadelphia	1,826	1,743	19,501
San Francisco	429	726	3,451
Totals	45,172	37,387	416,570

Total for 8 months ending Aug. 31, 1890, 335,921.

For the 8-month period of 1891, Austro-Hungary sent us 50,657 immigrants; Germany, 83,396; Great Britain and Ireland, 85,762; Italy, 54,835; Poland, 23,187; Russia (except Poland), 44,455; Sweden and Norway, 38,311. France sent us only 4,029 in the period named.

ACROSS THE CONTINENT IN 4½ DAYS is the record made by Mr. JOHN W. MACKAY this week. The route of 3,000 miles was over the Southern Pacific to Ogden, then on the Union Pacific to Council Bluffs, to Chicago, Buffalo and New York. A private car was used attached to the fast mail trains; and the same record could be made by any mail train were it not for the necessary stops. Mr. MACKAY said that when he first crossed the plains in 1866 it took him 22 days to make less than half the distance.

THE RAIN-MAKERS are in Corpus Christi, Texas, and a despatch from there says that their experiments were a success to the following extent: Broken clouds had been floating overhead all morning, but the discharge of volleys of four 20-lb. dynamite bombs at a time were immediately followed by a rain in each case. After firing twelve of these bombs a general rain set in and lasted 30 minutes. The party will next operate at points on the Mexican National Railway.

THE TEST OF ROAD-MACHINES in Mexico, Mo., referred to in a late issue, came off on Sept. 18. The mechanical experts were Prof. HIRAM PHILLIPS, of Columbia University, and GEORGE BURNET and M L. HOLMAN, of the Board of Public Works of St. Louis. The machines exhibited all made an excellent record, and were as follows: The Western, Light Champion, Fort Wayne Reversible, Mount Pleasant, and Austin. The scores ran from 95.7 to 110.6. The judges recognized the superior excellence of all the machines, some possessing advantages in one direction, and some in another. We expect to give a more detailed account shortly.

SIX "WHALEBACK" SHIPS, of 6,000 tons each, are reported from London as having been advertised for by the North German Lloyd line of steamers. Bids are to come from European and American builders. It is supposed that they are to be used for freight boats exclusively.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a head collision Sept. 23 on the Pittsburg & Western R. R. at McKims Siding, near Zelienople, Pa. A construction train and a gang of men were at work laying a new track. The train, after getting out of the way of a freight train, had run back onto the track, and the men were shoveling the dirt off the cars when the second section of the freight train came up without warning. The engines and several of the cars were badly smashed; 9 men were killed and about 20 injured, some of them fatally. Another serious accident was a head collision Sept. 30 on the New York, Pennsylvania & Ohio R. R., at Kent, O., on a high bank and trestle over the Pittsburg & Western R. R. The sixth section of a passenger train collided with the second section of a freight train. There were 4 persons killed and several injured. Both engines were wrecked. The baggage car and two passenger cars were smashed and telescoped, and the wreck caught fire from an overturned stove, but the flames were extinguished with water from the tanks on the other cars. The blame is said t rest with the crew of the freight train. They had instructions to wait at Ravenna until the sixth section of the excursion train passed. The conductor of the freight claims that there were no lights on the fifth section to indicate that another section was to follow. An extra freight train on the New York, New Haven & Hartford R. R. was derailed at Saugatuck, Conn., Sept. 23, by a derailing switch as the train passed a danger signal, but after running over the ties for some distance was put upon the track by a rerailing frog near the drawbridge and ran onto the draw. The switch is intended to derail trains which pass the signal indicating that the draw is open or about to be opened, while the frog is intended to rerail any accidentally derailed car or truck of a train that is signaled to cross the bridge. It would seem from the account as though the derailing switch was too near the bridge.

AN ACCIDENT ON THE RACK RAILWAY up Mount Washington, in New Hampshire, occurred Sept. 28; while the engine and a well-loaded train were descending the mountain the engine broke down, and for a few seconds descended rapidly before the brakes worked and the train was brought to a standstill. Another train had to be sent up the mountain, and to this the passengers were transferred.

ANOTHER EUROPEAN RAILWAY ACCIDENT is reported, this time on the Northern Ry., of Spain. On Sept. 24 an express train between Burgos and San Sebastian ran into a mixed train, owing, it is said, to the blunder of a telegraph or signal operator. There were about 20 people killed or fatally injured, and 30 injured; seven cars were wrecked. The Cabinet has decided to institute an inquiry and will hold the company responsible if negligence is proved. The company was ordered to abolish the obsolete Breguet system of telegraph still used on its line, and to increase the number of signalmen, it having been found that many of the latter have been employed 16 hours daily. The company has also been ordered to deposit a large sum of money to provide for the payment of damages.

THE COUNTY BRIDGE, which crosses Sonoma Creek at Embarcadero, Cal., collapsed Sept 17, precipitating 13 horses and 5 steers into the stream below.

BLAST-FURNACE STATISTICS, on Sept. 1, in the United States, are given as follows by the *American Manufacturer:*

Total number of charcoal stacks	125
Number in blast	60
Weekly capacity, tons	12,675
Number out of blast	65
Weekly capacity, tons	9,506
Total number of anthracite stacks	157
Number in blast	84
Weekly capacity, tons	32,338
Number out of blast	73
Weekly capacity, tons	24,501
Total number of bituminous stacks	248
Number in blast	158
Weekly capacity, tons	129,493
Number out of blast	90
Weekly capacity, tons	48,170

Twenty-two furnaces in the Pittsburg district are running and three are idle.

THE UNION ELEVATED RAILWAY, of Brooklyn, has seemingly not abandoned its efforts of last winter to bridge the East River. The directors have decided to make another effort, and President FREDERICK UHLMAN is now at work framing bills for presentation to the New York Legislature. He wants to form a company with a capital of $24,000,000, to build two bridges. The first would run from Broadway, in Brooklyn, to Grand St., in New York; its erection would be compulsory, and it would be used for foot, carriage and train traffic; the second bridge would be used for trains alone, and land at nearly the same point in New York. Mr. UHLMAN says the whole amount of capital required is "in sight."

STATISTICS OF HORSES AND MULES IN THE UNITED STATES, as given in Census Bulletin No. 103, show the following figures: On June 1, 1890, there were in all the states and territories, 14,976,017 horses, 2,246,936 mules, and 49,109 asses. The increase of horses between 1880 and 1890 was 44.59% as compared with 44.95% in the period 1870-80, and 14.34% in 1860-70. The increase of mules in 1880-90 was 26.66%; between 1870-80 it was 61.08%, and in 1860-70 there was a decrease of 2.24%. In June, 1890, out of the whole number of horses and mules, 86.95% were horses and 13.05% were mules. The greater number of mules are in the South Atlantic States, the figures being 32.04% of mules to 67.96% of horses.

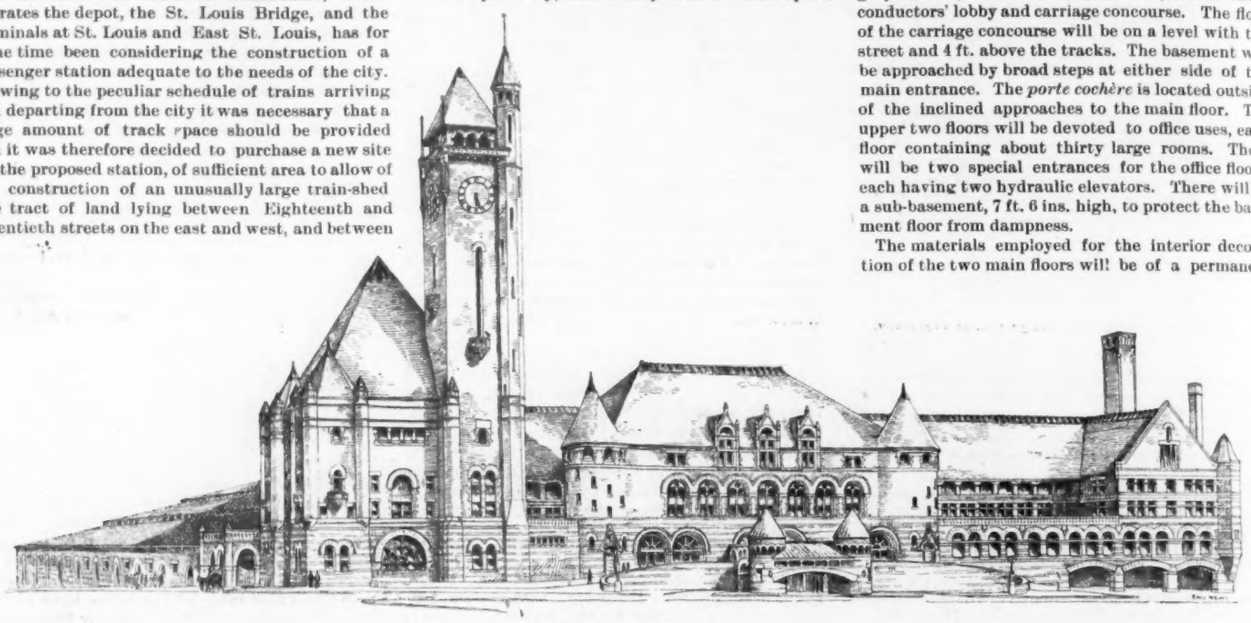
The St. Louis Union Passenger Station.

We illustrate herewith the first and second prize designs for the new Union Passenger Station to be erected at St. Louis, Mo. The facilities of the present union depot, situated at the corner of Twelfth and Popular streets, have for a long time been inadequate to the rapidly increasing passenger traffic, and the Terminal Railroad Association, which operates the depot, the St. Louis Bridge, and the terminals at St. Louis and East St. Louis, has for some time been considering the construction of a passenger station adequate to the needs of the city.

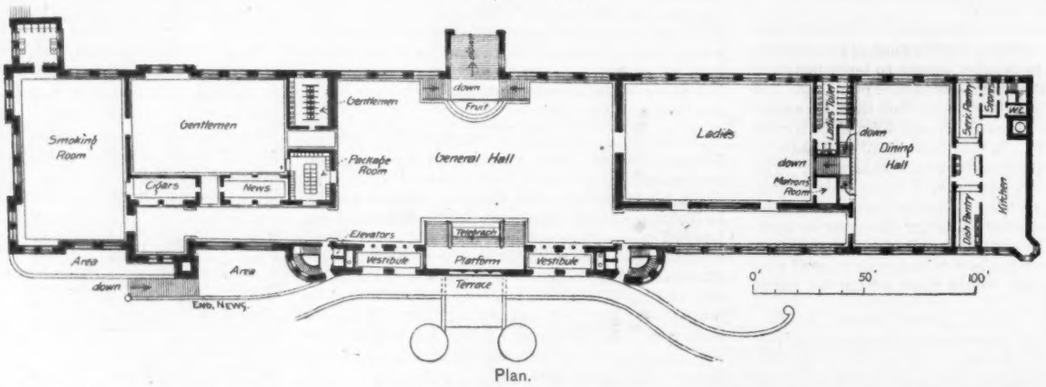
Owing to the peculiar schedule of trains arriving and departing from the city it was necessary that a large amount of track space should be provided and it was therefore decided to purchase a new site for the proposed station, of sufficient area to allow of the construction of an unusually large train-shed The tract of land lying between Eighteenth and Twentieth streets on the east and west, and between Market Street on the north and Clark avenue on the south was accordingly secured by the association at an expense of $1,250,000. This locates the new station directly west and a considerable distance from the present station, and somewhat nearer the center of the city. This location will necessitate a re-arrangement of the tracks, but just what this new arrangement will be has not been definitely decided. At present the main line tracks of the roads entering the city run almost directly east and west. The tracks in the train-shed will run north and south.

To enter the train-shed there will be two double track approaches from the main lines, one from the east and one from the west, converging to form a Y, the apex of which will be just outside of the train-shed. From this apex the tracks will diverge to connect with the tracks in the train-shed, 30 in number. By this arrangement all the tracks in the train-shed are accessible from either branch of the Y and from the main tracks in either direction. The total amount of track room inside and outside of the train-shed to the apex of the Y will be 19,260 lin. ft., or sufficient to stand 296 cars 65 ft. long each over all.

The train-shed will be 606 ft. wide and 650 ft. long, and, as before stated, will contain 30 parallel tracks. These tracks will be arranged in pairs, seven pairs each side of the center pair. Each pair of tracks will be separated by a platform 22 ft. 6 ins. wide, and between the ends of the track and the head house there will be a transverse platform 50 ft. wide. The distance between the tracks in each pair will be 12 ft., with the exception of the second pair on each side of the center pair and the second pair from each side respectively, where they will be 14 ft. apart.



Perspective View.



Plan.

FIG. 1. FIRST PRIZE DESIGN FOR ST. LOUIS UNION PASSENGER STATION. Theodore C. Link and Edware A. Cameron, Architects.

All of the tracks are on a slight rising grade of 0.048% entering the train-shed. The designs for the train-shed are not yet completed, but it is not proposed to cover the whole with a single roof span, there being four rows of pillars for intermediate support.

The accepted design for the station proper, shown in Fig. 1, was that submitted by THEODORE C. LINK and EDWARD A. CAMERON, of St. Louis. According to the conditions of the competition these gentlemen received the first prize of $10,000. The second prize, $1,500, was awarded to Grable & Weber, of St. Louis, who submitted the design shown in Fig 2. A third prize of $1,000 was given to Van Brunt & Howe, of Kansas City, Mo., and five other competitors received sums of $500 each. All designs become the property of the association.

The general style of the accepted design is Romanesque. The structure will be built of Missouri gray granite backed with brick up to the second story and of brick with stone trimmings above. The tower will be 200 ft. high. The building will be 456 ft. long and 80 ft. wide, and will have two floors devoted to general station uses. The main floor, which is shown in the cut, will be approached from the street by an inclined walk from either direction. It will contain a general waiting room of 10,530 sq. ft., a gentlemen's room of 3,300 sq. ft., a ladies' room, including matron's room and retiring rooms, of 5,760 sq. ft.; a dining room of 4,500 sq. ft., a smoking room of 2,340 sq. ft., and other rooms as shown. Two stairways will lead directly to the track platforms. The basement floor is on a level with the tracks and will contain a general concourse of 10,536 sq. ft., an emigrants' waiting room, ticket and telegraph offices, a restaurant, mail room, barber shop, conductors' lobby and carriage concourse. The floor of the carriage concourse will be on a level with the street and 4 ft. above the tracks. The basement will be approached by broad steps at either side of the main entrance. The *porte cochère* is located outside of the inclined approaches to the main floor. The upper two floors will be devoted to office uses, each floor containing about thirty large rooms. There will be two special entrances for the office floors, each having two hydraulic elevators. There will be a sub-basement, 7 ft. 6 ins. high, to protect the basement floor from dampness.

The materials employed for the interior decoration of the two main floors will be of a permanent character, and will not require painting. The walls of the rooms in the basement floor will be lined with enameled brick or tiles about 5 ft. high, and above this with buff Roman bricks. The ceiling will show exposed beams and the floors will be of marble. The walls of the main floor will be covered with a composition known as art marble, and the floors of the public rooms will be of mosaic.

Complete plans have been made for heating, lighting and ventilating the building. Steam radiators will be placed in each room. Fresh air for ventilation will be forced through heated flues by power fans, at a temperature of 70° F. The flues will be provided with dust screens and spray washers to remove the dust from the air and to prevent any discomfort from dry and heated air. All ventilating flues will discharge into the roof and will have self-closing valves at the top. The water closets will be so arranged that the circulation of air will be from the corridors to the closets and out through the exhaust flues. The boilers and engines will be under the carriage concourse.

Proposals have been invited from builders for constructing the building, and several bridge companies have been asked to submit designs and estimates for erecting the trainshed. The total cost of the building will be about $800,000.

The Stampede or Cascade Tunnel on the Northern Pacific R. R.

BY CHARLES W. HOBART.

Among the greatest feats of engineering skill at the present day is the making of tunnels through mountains of solid rock, under bodies of water, and through the soft earth for mining and traffic purposes. The ancients caught the idea of tunneling from the works of Nature, whose forces accomplished wonderful feats even before Man learned to control them for his own convenience.

The deep rocky cañons and caves in this and other countries show the power of running water. In Asia a hill is pierced by a river, forming a natural tunnel through which it flows. There is another natural tunnel of this precise nature in Eastern Tennessee through which a line of railway now runs. The Mammoth Cave of Kentucky, and similar subterranean chambers elsewhere, are instances of Nature's tunneling; as also are the caves and tunnels on the seashore, produced by the action of the waves and tides.

By these instances of nature's work in tunneling human effort was inspired many centuries ago. The tombs of kings and other renowned personages of Thebes were tunneled into hillsides for hundreds of feet, and the rock from which the pyramids were constructed was quarried by the Egyptians by driving a long tunnel into the mountain, from which cross and parallel galleries were driven, and large spaces, several hundred feet wide, were cleared, the rock being cut by tube drills, saws, etc. In the days when Babylon was among the greatest cities of the world a tunnel was made under the river Euphrates and arched with masonry. Again, whenever the Roman army, in its peregrinations, required subterranean passages for roads, water supply, drains, etc., tunnels were made. In these early periods the means for tunneling were rude, although the engineering may have been skillful, as was the case in the construction of a tunnel for the drainage of Lake Fucinus, completed A. D. 52. This tunnel was 3¾ miles in length and 22 shafts, some of them 400 ft. in depth, were used, through which the rock and dirt were hoisted in copper buckets by windlasses. We are told that it took 30,000 laborers 11 years to complete this work, which was then the longest tunnel in the world.

Coming down to the present century, the advent of the railway enormously increased the demand for tunnels to open highways through great natural barriers. Within the past 35 years stupendous feats of mountain tunneling for railway uses have been accomplished through the skill of engineers, and the courage and ability of contractors. While full details of nearly all these important works have been given in the columns of ENGINEERING NEWS, a brief résumé of some of them may be of interest.

The Mont Cenis tunnel, 7½ miles long, was commenced in 1857, and was worked by hand drills from both ends, until 1861, when machine drilling was applied. It was completed in 1871, making the total time of construction 14 years. The average progress was 7.71 ft. per day. The average cost was $380 per lineal foot. It is well to note that the cost of labor employed upon this work was only about one shilling, or 24 cts., per day, while in the United States similar labor costs from $3.50 to $4 per day.

The St. Gothard tunnel, 9½ miles long, was commenced in 1872, and completed in nine years. Compressed air drills were used throughout. From six to eight Ferroux drills, making 180 blows per minute, being attached to a carriage. The average rate of progress was 6.01 lineal yds. per day, and the cost was $740 per lineal yd. The system of tunneling adopted was to run upper headings 8 ft. square in advance.

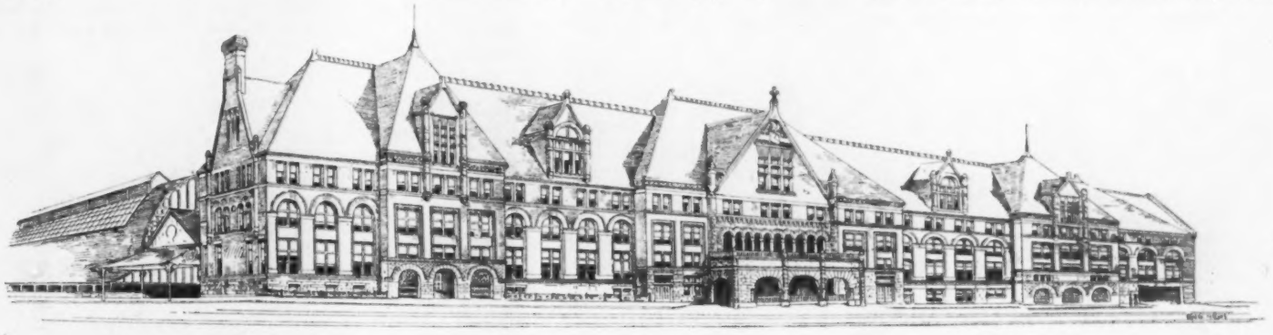
The Arlberg, the third of the Alps tunnels, 6½ miles long, was began in 1880, and completed in 1883—over three years. The average progress of the work was 9.07 lineal yds. per day, and the cost was $540 per lineal yd. This tunnel was worked from both ends, and the system of tunneling differed from the others in that the main heading was excavated from the bottom instead of from the top. Ferroux's percussion drills and Brandt's rotary hydraulic drills were used. Steam dump cars were used instead of mule cars, as in the Mt. Cenis and St. Gothard, which greatly expedited progress. The Hoosac tunnel, which extends through the solid slate rock of Hoosac Mountain, a distance of 4¾ miles, was commenced in 1855, and was completed in 1874—over 19 years. It cost the State of Massachusetts about $16,000,000. When the Hoosac tunnel was completed it was the longest tunnel in the world, except the Mt. Cenis. The St. Gothard and the Arlberg, since completed, however, both excel it in length, as above stated. The longest artificial tunnel in the world, however, is the new Croton Aqueduct tunnel, extending from the Croton dam to the Harlem river in New York City, a distance of 33¼ miles. It is 13½ ft. in width and height, and supplies the water for about a million and half of people.

We now come to what was, in some respects, the grandest achievement of them all, when all the difficulties overcome are taken into account, the Stampede or Cascade Tunnel.

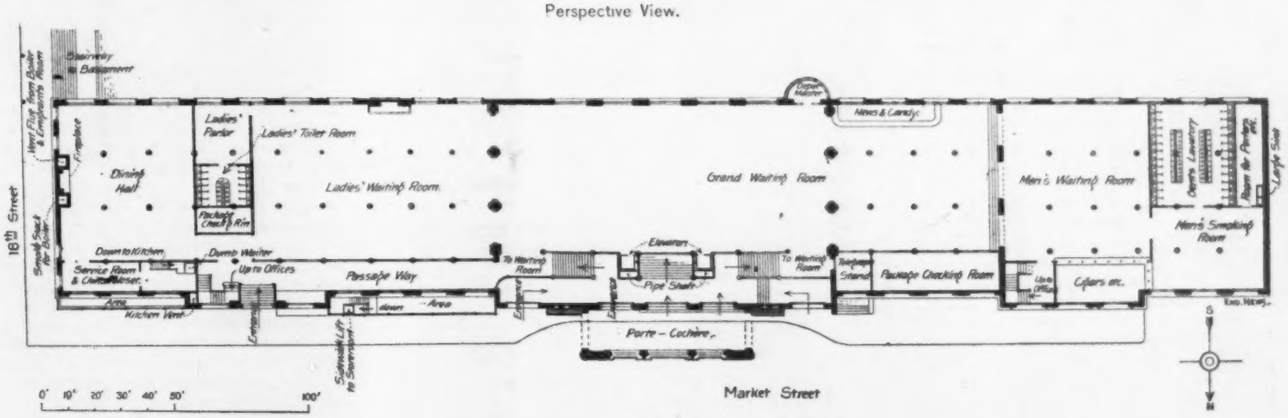
The Cascade range of mountains extends from British Columbia through Washington, Oregon and California, paralleling the coast of the Pacific at a distance of about 75 miles inland for its whole length. Its highest summits rival those of the Rocky Mountain range in altitude.

From the time it was determined to make Puget Sound the western terminus of the Northern Pacific Railroad, the question of a feasible route across the Cascade range for the road was prominently before the company. Between the years 1873 and 1884, several proposed routes were examined by the company's engineers, of which those via the Natches, Stampede and Snoqualmie passes were prominent. During this period there was considerable effort on the part of the city of Seattle to secure the selection of the Snoqualmie route, which would bring the railway tothat city as a terminus, and by Yakima and Tacoma to secure the adoption of the Natches route, which would make Tacoma the natural terminus.

The decision was left, however, largely to the judgment of Principal Assistant Engineer V. G. BOGUE, who finally recommended the Stampede route, lying between the other two routes. One reason for this choice was that the road would thus traverse the entire Yakima valley, including the most fertile portion of Kittitas County. This route as recommended by Mr. BOGUE, was adopted by the company in the fall of 1884. Each of the routes required a tunnel through the backbone of the Cascade range; but the Stampede tunnel was the longest of the three.



Perspective View.



Plan.

FIG. 2. SECOND PRIZE DESIGN FOR ST. LOUIS UNION PASSENGER STATION. Grable & Weber, Architects.

The altitude of the mountain beneath which it was necessary to tunnel is 3,970 ft. above the sea level, and the greatest thickness over the top of the tunnel is more than 1,400 ft., the average depth being about 1,200 ft. The elevation of the east portal of the tunnel above the sea is 2,827 ft., and that of the west portal is 2,800 ft.

In 1885, the year after the adoption of the Stampede Pass route, the final location of the tunnel was made, with but slight deviation from the preliminary line. To secure the greatest possible accuracy, the large and dense coniferous timber was slashed down along the line of the tunnel over the mountain through which it was to be driven, in order to check the alinement and establish bench marks and reference points over and at each end of the tunnel. Tree trunks about 4 ft. in diameter were cut into sections 5 ft. long, and these were piled on top of each other to form signal towers. The line was thus carried over the mountain with the use of long sights and few stations, the latter located as nearly equidistant as possible, thus diminishing the chances of error.

It should be especially noted that only the ordinary instruments were used in making the final location over the mountain, and in carrying the line into and through the tunnel the only extra attachment used was a very sensitive bubble fixed to the axis of the telescope of the transit, at right angles to the line of sight. I am informed by engineers, and through records of tunnel surveys in this and other countries exceeding a mile in length, that special instruments are generally used for such work. As noted further on, the alinement and grade of this tunnel did not vary an inch when the two ends met.

On Jan. 21, 1886, 12 bids were opened at the Northern Pacific offices, in New York City, for boring a tunnel about two miles long through the Cascade Mountain range and completing it in 28 months. Of these bids that of NELSON BENNETT was the lowest. The Northern Pacific engineers made a thorough survey of the site of the work and the facilities for reaching it with materials, investigated improvements in rock drilling machinery, and concluded that the work could be done within 28 months. Other bidders of practical experience in such work fixed their figures at double those of Mr. BENNETT, because of the limit of time in which the work must be completed under forfeit of $100,000 and 10 per cent. of the entire contract price besides, and because of the great difficulties confronting them in getting their machinery, etc., on the ground.

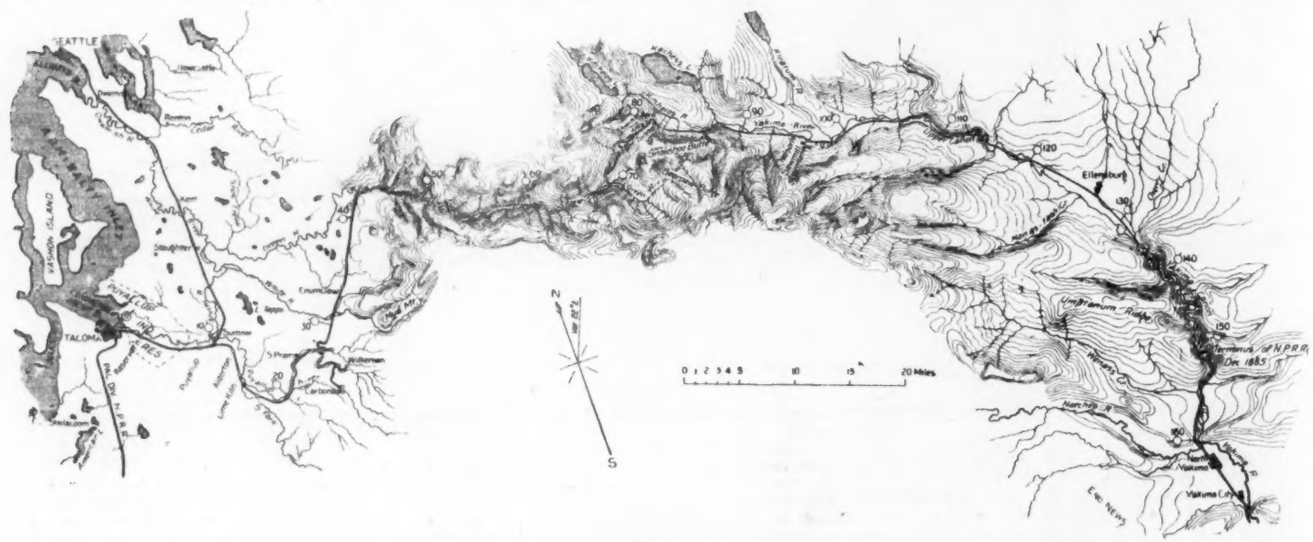
So short was the time and so grave the difficulties that Mr. BENNETT submitted two bids—one for completing the work within the 28 months required under the stated forfeit, and another bid, $100,000 less in amount, conditioned on a release from the time limit and reliance on his agreement to push the work at the highest possible speed. This second bid, however, the company declined to consider; but it accepted the first bid, and a contract was on that day signed by which Mr. BENNETT agreed to complete the tunnel within 28 months from Jan. 21, 1886.

Mr. BENNETT had been a railroad contractor since 1881, and had constructed over 250 miles of the Northern Pacific through Montana, under the firm name of Washington Dunn & Co., and about 150 miles of the same railway from the Columbia River toward the Cascade range in Washington, on which he was engaged when the tunnel contract was awarded him. One of the controlling reasons why Mr. BENNETT bid so much lower than some of his competitors was his confidence in the conclusion of the engineers that the work could be done within the prescribed time. He knew them personally and had done contract work under them, while the other bidders, lacking this knowledge, hesitated to rely on the engineers' close estimates. Another reason was his practical experience of what could be done in hastening work by a judicious selection of men and appliances with which to work.

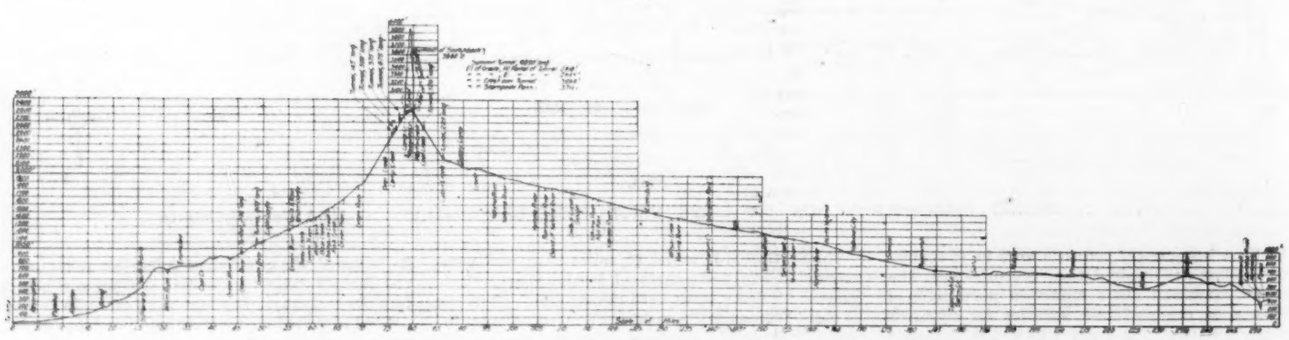
On the day the tunnel contract was executed Mr. BENNETT telegraphed his General Manager, Capt. SIDNEY J. BENNETT, at Yakima, to gather a force at once and clear a road to get the machinery on the ground. This Mr. BENNETT purchased and shipped while in New York. The equipment consisted of 5 engines, 2 water wheels, 5 air compressors, 8 70-HP. boilers, 4 large exhaust fans, 2 complete electric arc light plants, 2 miles of 6-in. wrought iron pipe, 2 miles of water pipe, 2 fully equipped machine shop outfits, tools, etc., 36 air drilling machines several tons of steel drills, 2 locomotive engines, 60 dump cars, 2 saw mill outfits, one for each end, telephones for each end of tunnel and each working point therein, and other necessaries of less interest from an engineering standpoint.

All this plant was shipped by rail to Yakima, Wash., then the end of the track of the Northern Pacific transcontinental line. From this point it had to be transported on wagons and sleds a distance of 82 miles to the east end and 87 miles to the west end of the tunnel. The first wagon loads started Feb. 1, and the first compressor boiler Feb. 22, 1886. It took from this time until June 19 to haul the machinery and implements to the east portal and place it in operation, and it was not until July 15 that the machinery reached the west portal—only 7 miles further—and was in place ready for operation. Meantime, however, a force of men reached the east portal Feb. 1, to clear the approach. On Feb. 13 hand drilling was started, and 411 ft. had been driven on June 19, when machine drilling commenced. About March 1 a force of men also reached the west end to clear the approach, and on March 15 hand drilling was started. The work had extended 483½ ft. at this end when machine drilling began, Sept. 1, 1886.

The most difficult part of this great undertaking



Plan.



Profile.

PART OF NORTHERN PACIFIC RAILROAD, SHOWING LOCATION OF CASCADE TUNNEL.

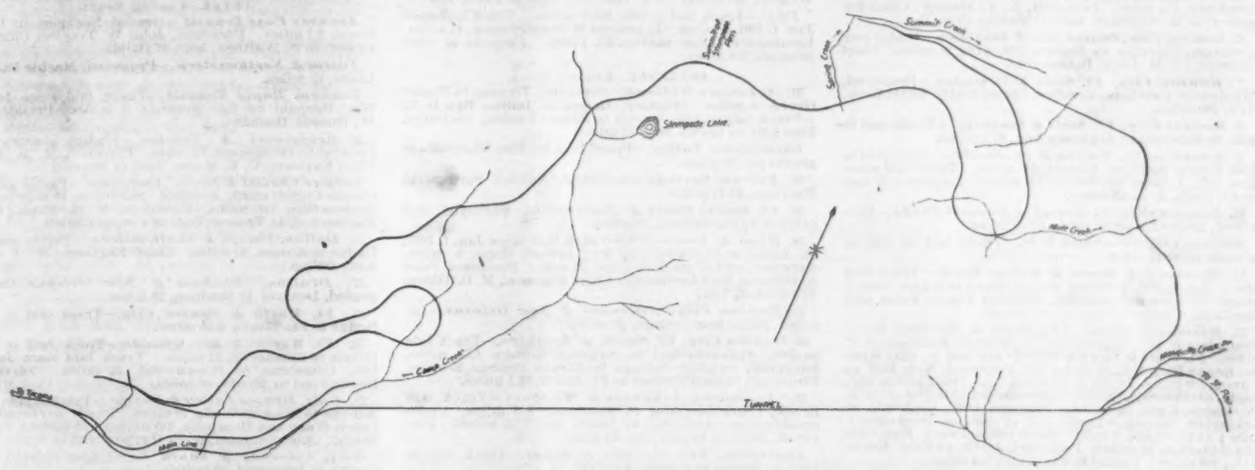
was this assembling of men and materials in preparation for the actual work. Getting the machinery on the ground was a herculean task; and nothing is hazarded in the assertion that not one man in a thousand would have had the courage to persevere in the work in the face of the difficulties and delays encountered. As before noted, the machinery and material were transported by wagons and sleds 82 and 87 miles between Feb. 1 and July 15, from an altitude of about 500 ft. to that of 4,200 ft. (the machinery for the west end having been hauled across the summit of the divide), through deep mud and snow, and for much of the distance through thick and heavy coniferous forests and over steep mountains.

For the entire distance, until the mountain range was reached, the course was over hills, through valleys, across streams, and much of the way along an untraveled route. For the last 15 miles of this distance before ascending the Cascade range, the mud was so deep (the result of a "Chinook" or thaw) that it was impossible for the double teams to haul the wagons, which sank in the mire to the hubs. To overcome this difficulty, planks had to be brought from saw-mills, miles in the rear, and laid down lengthwise in front of the wheels of each wagon of the train. As fast as the train passed over this improvised tramway, the planks were hauled to the front and laid down again. The mode of hauling the wagons over these planks was by block and tackle, with the rope tied to the end of the wagon tongue and a team attached to the other end, while the men guided the wagons on the planks by the tongue. By this means all the heavily loaded wagons of the train were worked along over the 15 miles of miry road at the rate of about one mile a day.

These difficulties passed, the ascent of the mountains began and the obstacles to the journey were increased. Snow was encountered so deep that it was necessary to improvise sleds from small fir trees and transfer the loads of heavy machinery, etc., from the wagons to these sleds for transportation the remaining distance. So difficult and perilous was the new-made road, running along gorges 500 to 1,000 ft. deep, and precipitous mountain sides where it was impossible for the teams to haul the loads, that the block and tackle had to be again used for hauling. By its aid the heavy loads were slowly worked along for 8 or 10 miles until the east end of the tunnel was reached; and part of them had then to go seven miles farther to the west end of the tunnel.

The preparation and organization necessary for this great work were stupendous. Like an army, it required a corps of men to move in advance to cut and prepare the road, build bridges where required and establish camps and way stations. These were located at intervals of about 12 miles along the road from the base of supplies to the tunnel, about the distance a loaded team would make in a day. Canvas tents were pitched and accommodations were provided for lodging the men and teams hauling supplies up to the tunnel. To all these stations supplies were furnished from time to time as required. During the four months in which machinery and implements were being transported from Yakima to the tunnel there were upward of 100 teams on the route and several hundred men. The progress of the heavily loaded teams was so slow—from one to five or six miles a day—that tents and supplies were carried with them and camp was made wherever night overtook them if they failed to reach a station.

Besides the great task of hauling the machinery and supplies to the tunnel, preparations had to be made at the same time for establishing the plant at each end and also pushing the work as far as possible with hand drills. The following extract from the first report of the superintendent of the work to the general office of Mr. BENNETT, at Tacoma, will give an idea of the obstacles met in this part of the work:



PLAN OF SWITCHBACK OVER CASCADE RANGE, ON NORTHERN PACIFIC R. R.

FEB. 13, 1886.

On Feb. 9 I found things at Cascade tunnel thus: Before we could get to the east end of the tunnel we had to shovel a road 100 ft. long through snow 6 to 8 ft. deep. At the face of the tunnel there were 200 miner's ins. of water falling from the top of the bluff, 170 ft. above, which had to be turned. We made a cut through snow and ice 20 ft. wide, 8 to 10 ft. deep and 150 ft. long, to get to the portal of the east end. In order to reach the west portal it was necessary to shovel a trail 4 ft. wide and 4 miles long through snow from 4 to 20 ft. deep. The grade of the railroad is 20 ft. below the bed of the creek, and 10,000 yds. of solid rock excavation must be made before it can be reached, and also a 1,600-ft. haul for waste dump.

Besides this, houses in which to feed and lodge the men, stables for the horses, saw-mills, machine and other shops, stores for supplies, etc., had to be erected at each end of the tunnel. For those at the east end 20 ft. of snow had to be shoveled away to get a ground foundation, and when built the snow was several feet above some of them. At the west end 15 ft. of snow had to be shoveled away for the same number and character of buildings.

The mountain through which the tunnel is pierced is the backbone, so to speak, of the Cascade range at that point. Two of the largest rivers of the state have their source at the foot of this mountain. One, the Yakima, rises a few miles north of the eastern portal of the tunnel and flows eastward to a junction with the Columbia River at Pasco, forming a chain of breaks in the hills and mountains. The other stream, the Green River, rises a few miles south of the tunnel, courses along the western base of the same mountain, and flowing westward from near the west portal of the tunnel, forms a series of passes through the mountains and foothills to Puget Sound.

As seen by the accompanying map, the valleys of these two rivers formed a favorable route for the railway line, and enabled it to reach the heart of the Cascade range from either side, where only the main backbone of the range remained to be pierced. Moreover, the broad and fertile valleys of these rivers, along which the Northern Pacific R. R. extends from Puget Sound to the Columbia River, 250 miles, furnish the road with a vast amount of traffic.

Before the railway was completed to the east end of the tunnel, it was determined to build a temporary line across the mountains for use until the completion of the tunnel. Its grade was 300 ft. per mile, and several switchbacks were used, as shown on the accompanying map. This bold and skillful piece of engineering was executed under the direction of Mr. H. S. HUSON, Principal Assistant Engineer of the Northern Pacific R. R., after the retirement of Mr. BOGUE.

The switchback was planned and constructed as a matter of direct economy, as well as for the benefit gained in hastening the opening of the through transcontinental line. It cost the railroad company $400,000, and the receipts from the business over it from its completion, July 2, 1887, to the completion of the tunnel, May 14, 1888, were about $500,000.

Travelers over the line who had the good fortune to cross the mountains by the switchback line were amazed at the genius and boldness with which the engineer had planned this remarkable railway, especially on the western slope of the range, near the west portal of the tunnel, where five tracks were visible, one above the other, zigzagging up the mountain side. Frequent also were their exclamations at the courage and energy of the contractor when they saw the zigzag road cut through the heavy forest along the steep mountain side up which he had hauled the heavy machinery required for boring the tunnel.

I doubt whether any tunnel was ever undertaken where the difficulties and the cost in reaching the site and preparing for work were so great as at the Cascade tunnel. About six months were occupied in clearing the way and getting the machinery and material to the work, at a cost to the contractor of $125,000, before the tunnel work was commenced. The St. Gothard and Arlberg tunnels in the Alps, and the Hoosac in this country, were attended with no such difficulties, as they were built in old settled countries. Not only were great depths of snow encountered in the Cascade mountains, but the course of two streams of water had to be changed at each end of the tunnel. One of these, at the east end, fell directly over the portal a distance of 170 ft. from the steep cliff above.

(Concluded next week.)

Legal Decisions of Interest to Engineers.

Powers of Board of Public Works and City Council.—Where the charter of a city gives the Common Council power to order the improvements of streets, and empowers the Board of Public Works to determine the particular kind and quantity of materials to be used therefor, the Council may order the construction of a certain class of pavement, such as "Macadam," or "wood block," and the Board of Public Works must conform to this direction. Their discretion is limited to the details of the work. —Com. Council of Grand Rapids, v. B. of Pub. Wks., Supr. Ct., of Mich., 49 N. W. Rep. 481.

Permitting Use of Railway Track by Pedestrians.—Where a railroad company positively permits the public to use its tracks or a portion of them as a highway, persons so using it are not trespassers, but are there by license and permission implied, and the company is liable to them for any injuries sustained by or through the negligence of its employees and servants.—LeMay v Mo. Pac. Ry. Co., Supr. Ct. Mo., 16 S. W., 1049.

Statistics Showing the Progress and Prospects of Railway Construction in the Southwestern States.

[WITH MAP NO. 38.]

MISSOURI.—Existing Roads.

1. ***Chicago & Kansas City.***—Located, Smithville to Gower, 16 miles.

2. ***Chicago, St. Paul & Kansas City.***—Track laid in 1890, Bee Creek to Beverly Junction, 25 miles.

3. ***Cleveland, St. Louis & Kansas City.***—Partly graded, St. Charles to Alton, 20 miles; Hamburg to Pinkney, 36 miles. Projected, Pinkney to Kansas City, 202.5 miles.

4. ***Greenfield & Northern.***—Under construction, South Greenfield to Mt. Vernon, 36 miles.

5. ***Hamilton & Kingston.***—Track laid in 1890, Hamilton to Kingston, 8 miles. Projected, Hamilton to Gainesville, 50 miles.

Kansas City & Independence Air Line.—Under construction, Kansas City Suburban Belt R. R. to Independence, 5½ miles. President, A. A. Mosher; Chief Engineer, J. H. Heylman, both of Kansas City, Mo.

6. ***Kansas City, Bentonville & Southern.***—Under construction, Pineville to Bentonville, Ark., 25 miles. Chief Engineer, T. M. Long, Bentonville.

7. ***Kansas City, Ft. Scott & Memphis.***—Projected, Minden to Carthage, 25 miles; Springfield to Little Rock, Ark, 200 miles.

8. ***Kansas City, Ft. Scott & Southern.***—Track laid in 1890, Splitlog to the Arkansas line, 20.5 miles.

9. ***Kansas City, Nevada & Ft. Smith.***—Track laid in 1890, Grand View to Amoret, 47 miles. Track laid since Jan. 1891, Amoret to Hume, 12 miles. Projected, Hume to Ft. Scott, Ark., 25 miles.

10. ***Kansas City, St. Joseph & Council Bluffs.***—Surveyed, Rushville to Sugar Lake, 5 miles.

Kansas City Suburban Belt.—Track laid in 1890, in Kansas City, 12 miles.

11. ***Mississippi River & Bonne Terre.***—Track laid since Jan. 1, 1891, between Bonne Terre and Doe Run, 5 miles. Under construction, between Bonne Terre and Doe Run, 11 miles.

12. ***Missouri Pacific.***—Ft. Scott & Southern Ry.—Track laid in 1890, Kansas line to Minden Junction, 16.27 miles. Ft. Scott & Eastern Ry.—Track laid in 1890, Kansas line to Rich Hill, 21.33 miles. Projected, Rich Hill to Tipton, 100 miles. Joplin & Western Ry.—Track laid in 1890, Joplin southwest, 2.5 miles. Under construction, end of track to Seneca, Kan., 10 miles. Jefferson City, Boonville & Lexington Branch.—Track laid in 1890, at Boonville, 1 mile; at Carthage, 1 mile. Surveyed, between Boonville and Jefferson, 46 miles. Projected, Joplin to Bald Knob, Ark., 200 miles; Bagnel to Carthage, 125 miles.

13. ***Montgomery & Western.***—Track laid since Jan. 1, 1891, Montgomery west, 2.5 miles. Surveyed, Montgomery to Glasgow, 74 miles. President, James Ferguson; Chief Engineer, J. S. McCleary; both of Montgomery City.

Rockport, Langdon & Northern.—Track laid in 1890, Langdon northwest, 6 miles.

14. ***St. Louis & Hannibal.***—Located, Perry to New London, 18 miles; Oakwood to Hannibal, 3 miles.

15. ***St. Louis, Cape Girardeau & Ft. Smith.***—Surveyed, Hunter to Mammoth Springs, Ark., 45 miles.

16. ***St. Louis, Kennett & Southern.***—Track laid, Campbell to Kennett, 25 miles. Projected, Kennett to Memphis, Tenn., 80 miles.

17. ***Williamsville, Greenville & Northern.***—Track laid since Jan. 1, 1891, Williamsville to Greenville, 12 miles.

Projects and Surveys.

Kansas City Link.—Located belt line at Kansas City, 27 miles.

18. ***Reed Springs & Kansas City.***—Surveyed, Liberty to Birmingham, 4 miles. President, Samuel Hardwicke; Chief Engineer, Gustave Dyer; both of Liberty.

19. ***St. Louis, Collinsville & Carondelet.***—Surveyed, Madison to East Carondelet, 50 miles. President, A. M. Powell; Chief Engineer, S. A. Mitchell; both of Collinsville.

20. ***Springfield, Sedalia, Marshall & Northern.***—Surveyed, Springfield to Chillicothe, 205 miles. President, L. L. Bush, Philadelphia, Pa. Chief Engineer, A. M. Nelson, Springfield.

Total.—Track laid in 1890, 183.6 miles. Track laid since Jan. 1, 1891, 31.5 miles. In process of construction, 125 miles. Located or under survey, 443 miles. Projects of some promise, 527 miles.

KANSAS.—Existing Roads.

21. ***Burlington & Missouri River.***—Surveyed, Oberlin to Pueblo, Colo., 275 miles.

22. ***Hutchinson & Southern.***—Track laid in 1890, Kingman to the Indian Territory line, 50.3 miles.

12. ***Missouri Pacific.***—Ft. Scott & Southern Ry.—Track laid in 1890, Ft. Scott to the Missouri line, 9 miles. Ft. Scott & Eastern Ry.—Track laid in 1890, Ft. Scott to the Missouri line, 4.95 miles. Ft. Scott Belt & Terminal Ry.—Track laid in 1890, belt line at Ft. Scott, 4.75 miles.

23. ***St. Louis & San Francisco.***—Track laid since Jan. 1, 1891, Weir City, southwest, 2 miles.

24. ***Topeka, Westmoreland & Marysville.***—Partly graded, Topeka northwest, 55 miles. Surveyed, 55 miles post to Odell, Neb., 55 miles. Chief Engineer, Robert Giles, North Topeka.

Projects and Surveys.

Omaha, Kansas Central & Galveston.—Projected, Omaha, Neb., to the Gulf of Mexico, 900 miles. President, Jacob Newberger, 111 Broadway, New York City. Chief Engineer, Edward Roemer, 177 East Ninety-third St., New York City.

Total.—Track laid in 1890, 69 miles. Track laid since Jan. 1, 1891, 2 miles. In course of construction, 58 miles. Located or under survey, 181 miles. Projects of some promise, 310 miles.

INDIAN TERRITORY—Existing Roads.

25. ***Atchison, Topeka & Santa Fe.***—Track laid in 1890, Ardmore to coal mines, 4.5 miles.

26. ***Chicago, Rock Island & Pacific.***—Track laid in 1890, Okarche to Minco, 2.59 miles. Surveyed, Minco to the Red River, 125 miles.

27. ***Choctaw Coal & Railway Co.***—Track laid in 1890, Hartshorn to Wister, 50 miles. Seneca west, 2 miles; Ft. Reno east, 15 miles. Track laid since Jan. 1, 1891; end of track toward Oklahoma City, 6 miles. Under construction, end of track to Oklahoma City, 11 miles. Surveyed, South McAlister to Oklahoma City, 102 miles. Projected, Wister Junction to Little Rock, Ark., 148 miles; Ft. Reno, west, 125 miles.

22. ***Hutchinson & Southern.***—Projected—Kansas line to Texas line, 250 miles.

12. ***Missouri Pacific.***—Track laid in 1890. Cherokee Junction, south, 4.9 miles. Surveyed, Wagoner to Denison, Tex., 180 miles.

Projects and Surveys.

28. ***Ft. Gibson, Tallequah & Great Northern.***—Projected, Ft. Gibson to Rogers, Ark., 85 miles. President, J. E. Crane, Siloam Springs, Ark. Chief Engineer, S. G. Robertson, Bentonville, Ark.

29. ***Guthrie, Reno City & Ft. Reno.***—Surveyed, Guthrie to Ft. Reno, 41 miles. President, A. Jennings, Anthony, Kan.

30. ***Paris, Choctaw & Little Rock.***—Surveyed, Paris, Tex., to Hooks Ferry, Tex., 30 miles. Projected, Hooks Ferry to Little Rock, Ark., 180 miles. President, S. J. Wright; Secretary, B. J. Baldwin; both of Paris, Tex.

Total.—Track laid in 1890, 105.9 miles. Track laid since Jan. 1, 1891, 6 miles. In process of construction, 11 miles. Located and under survey, 471 miles. Projects of some promise, 958 miles.

ARKANSAS.—Existing Roads.

31. ***Arkansas Midland.***—Surveyed, Trenton to Poplar Grove, 5 miles. Brinkley, Helena & Indian Bay R. R.—Track laid in 1890, branch to Jones', 3 miles; projected, Pine City to Indian Bay, 12 miles.

Cache River Valley.—Track laid in 1890, Shotwells to gravel pit, 20 miles.

32. ***Eureka Springs.***—Surveyed, Eureka Springs to Harrison, 49.25 miles.

33. ***Ft. Smith, Paris & Dardanelle.***—Surveyed, end of track to Dardanelle, 70 miles.

34. ***Hope & Lewisville.***—Track laid since Jan. 1, 1891, St. Louis & Southwestern Ry., toward Hope, 3 miles. Surveyed, end of track to Hope, 21 miles. President, John A. Roberts, New Lewisville. Chief Engineer, M. D. Tilson, Texarkana, Tex.

35. ***Kansas City, Arkansas & New Orleans.***—Located, Beebe to Stuttgart, 50 miles.

8. ***Kansas City, Ft. Smith & Southern.***—Track laid in 1890, Arkansas line to Sulphur Springs, 1.75 miles. Surveyed, Sulphur Springs to Siloam Springs, 25 miles. Projected, Siloam Springs to Ft. Smith, 82.1 miles.

36. ***Louisiana, Arkansas & Missouri.***—Track laid in 1890, Tripp Junction to Amburns, 8.5 miles. Under construction, Amburns to Delhi, La., 75.5 miles. Surveyed, Delhi to Bryan City, 30 miles.

Louisville, New Orleans & Texas.—Track laid in 1890, on incline at Helena, 9 miles.

37. ***Memphis, Little Rock & Indian Territory.***—Under contract, Argenta to Hot Springs, 59 miles. Surveyed, Hot Springs to Indian Territory line, 91 miles. Chief Engineer, H. A. Schwanecke, Little Rock.

38. ***Mississippi & Little Rock.***—Track laid in 1890, between Duncan and Little Rock, 6 miles. Track laid since Jan. 1, 1891, 21 miles. Graded, 33 miles.

12. ***Missouri Pacific.***—Houston, Central Arkansas & Northen Ry.—Track laid, McGehee to the Louisiana State line, 27.26 miles. Camden & Alexandria Ry.—Track laid since Jan. 1, 1891, Camden to El Dorado, 32.5 miles; surveyed, El Dorado to Alexandria, La., 110 miles.

39. ***Pine Bluff, Monroe & New Orleans.***—Projected, Swan Lake to the Stuttgart & Arkansas River R. R., 20 miles.

40. ***Prescott & Northwestern.***—Track laid since Jan. 1, 1891, Prescott to near Wallaceburg, 8 miles. Under construction, end of track to the Little Missouri River 7 miles. Chief Engineer, Geo. E. Mantz, Prescott.

41. ***Stuttgart & Arkansas River.***—Track laid in 1890, Stuttgart to De Witt, 25 miles. Under construction, De Witt to Pendleton, 20 miles.

42. ***Texarkana & Ft. Smith.***—Track laid since Jan. 1, 1891, Tullock to Wilton, 15 miles.

43. ***White & Black River Valley.***—Projected, Jacksonport to Batesville, 22 miles.

Projects and Surveys

44. ***Beebe, Des Arc & Brinkley.***—Projected, Beebe to Brinkley, 48 miles. General Manager, F. P. Laws, Beebe.

45. ***Kansas City, Springdale & Clarksville.***—Projected, Springsdale to Clarksville, 100 miles. C. W. Schneider, Bentonville.

46. ***Magnolia & Southern.***—Projected, Magnolia to State line, 25 miles. President, T. J. Elmore; Chief Engineer, E. Elmore; both of Magnolia.

47. ***Richmond & Rocky Comfort.***—Projected, Kellar to Rocky Comfort, 20 miles. F. L. Hamilton, Rocky Comfort.

48. ***Southern Arkansas.***—Projected, Dry Run to Hampton, 23 miles. President, John Bagley, Chicago, Ill. Chief Engineer, John Brantley, Dry Run.

Total.—Track laid in 1890, 133 miles. Track laid since Jan. 1, 1891, 47 miles. In process of construction, 174 miles. Located and under survey, 331 miles. Projects of some promise, 982 miles.

LOUISIANA.—Existing Roads.

49. ***Kansas City, Watkins & Gulf.***—Track laid in 1890, Lake Charles north 10 miles. Track laid since Jan. 1, 1891, 10 mile post to 50 mile post, 40 miles. Under construction, end of track to Alexandria, 50 miles. Chief Engineer, P. H. Philbrick, Lake Charles.

50. ***Louisiana & Northwest.***—Projected, Beinville to Alexandria, 90 miles.

51. ***Louisiana Nickel Plate.***—Track laid since Jan. 1, 1891, Veline to Allentown, 2.5 miles. Under construction, Allentown to near Belvue, 12 miles. W. G. Wadley, Houghton.

Louisiana, New Orleans & Texas.—Track laid since Jan. 1, 1891, Latcher to Mills, 6 miles.

12. ***Missouri Pacific.***—Houston, Central Arkansas & New Orleans Ry.—Track laid in 1890, Arkansas line to Mer Rouge, 19.41 miles. Track laid since Jan. 1, 1891, near Alexandria, 2.5 miles. Under construction, between Alexandria and Columbia, 72.5 miles.

52. ***Natchez, Red River & Texas.***—Projected, Trinity to Alexandria, 42 miles.

53. ***New Orleans & Northwestern.***—Track laid in 1890, Sycamore Station to Rayville, 66 miles. Partly graded, Rayville to Bastrop, 25 miles.

New Orleans, Ft. Jackson & Grand Isle.—Track laid in 1890, end of track south, 33 miles. Track laid since Jan. 1, 1891, Socola to Ziblich, 12.3 miles; branch toward Grand Isle, 1.3 miles. Under construction, Socola to Barataria Bay, 10 miles; Ziblich to Buras, 7 miles.

Projects and Surveys.

Aveyelles Construction Co.—Projected, Texas & Pacific R. R. to Moreauville, 12 miles. President, John Ewell, Evergreen.

Bayou Lafourche Central.—Projected, St. James to Lake Verret, 20 miles. President, Joseph Maille, New Orleans.

54. ***Kansas City, Louisiana & Gulf.***—Surveyed, Arcadia to Boyce, 87 miles. Chief Engineer, Joseph Waitz, Atchison.

Iberia & Vermillion.—Projected, New Iberia to Abbeville, 15 miles. President, Aug. Erath, New Iberia.

Total.—Track laid in 1890, 128.4 miles. Track laid since Jan. 1, 1891, 65 miles. In process of construction, 212 miles. Located and under survey, 307 miles. Projects of some promise, 284 miles.

TEXAS.—Existing Roads.

Aransas Pass Transit—Graded, Rockport to Lighthouse, 9.5 miles. President, John W. Traylor; Chief Engineer, B. S. Walthen; both of Dallas.

Austin & Northwestern.—Projected, Marble Falls to Llano, 15 miles.

Bonham Rapid Transit.—Track laid since Jan. 1, 1891, Bonham to fair grounds, 3 miles. President, J. W. Russell, Bonham.

55. ***Bridgeport & Decatur.***—Under construction, Decatur to Bridgeport, 12 miles. President, M. R. Lock. Chief Engineer, C. E. Moore, both of Decatur.

Corpus Christi & South American.—Partly graded, Corpus Christi south, 40 miles. Surveyed, 40 mile post to Brownsville, 110 miles. President, E. H. Ropes; Chief Engineer, J. D. Thayer; both of Corpus Christi.

56. ***Dallas, Pacific & Southeastern.***—Partly graded, Dallas to Aurora, 45 miles. Chief Engineer, W. J. Sherman, Dallas.

57. ***Denison, Bonham & New Orleans.***—Partly graded, Denison to Bonham, 28 miles.

58. ***Ft. Worth & Denver City.***—Track laid in 1890, Hodge to Ft. Worth, 5.53 miles.

59. ***Ft. Worth & Rio Grande.***—Track laid in 1890, Dublin to Comanche, 22 miles. Track laid since Jan. 1, 1891, Comanche to Brownwood, 31 miles. Surveyed, Brownwood to Brady, 44 miles.

60. ***Gulf, Brazos Valley & Pacific.***—Track laid in 1890, Milsaps to Mineral Wells, 10 miles. Partly surveyed, between Waco and Henrietta, 180 miles. President, C. W. White; Chief Engineer, G. B. Gurley; both of Waco, Tex.

Gulf, Colorado & Santa Fe.—Under construction, Conroe to Ironwood, 40 miles.

Haines Medina Valley.—Partly graded, Castroville to Lacoste, 7 miles.

61. ***Hearne & Brazos Valley.***—Graded, Hearne to Mumford, 11.4 miles. Surveyed, Mumford to Steel's Store, 4 miles. President, T. C. Westbrook; Chief Engineer, W. S. Williams; both of Hearne.

62. ***Houston & Texas Central.***—Track laid in 1890, Hutchins to Lancaster, 4.76 miles.

Houston Belt & Magnolia Park.—Track laid in 1890, in city of Houston, 6 miles. Surveyed, Magnolia Park to main line, 2 miles; branch to G. H. & H. R. R., 0.5 mile.

63. ***Missouri, Kansas & Texas.***—Track laid in 1890, Waxahatchie toward Hillsboro, 20.02 miles. Track laid since Jan. 1, 1891, Milford to Hillsboro, 15.8 miles. Partly graded, Smithville to Lockhart, 86 miles; Boggy Tank to Sealey, 29 miles.

64. ***Paris, Marshall & Sabine Pass.***—Surveyed, Paris to Marshall, 100 miles.

65. ***Pecos Valley.***—Track laid in 1890, Pecos City to the New Mexico line, 50 miles.

66. ***Red River & Southwestern.***—Under construction, Henrietta to Archer City, 30 miles. Projected, Archer City to Albany, 70 miles. Chief Engineer, B. S. Wathen, Henrietta.

67. ***Red River, Sabine & Western.***—Surveyed, Palestine to San Augustine, 110 miles. Projected, San Augustine to Alexandria, La., 125 miles; Palestine to Fort Worth, 115 miles.

68. ***San Antonio & Aransas Pass.***—Track laid in 1890 between West Point and Waco, 12 miles. Track laid since Jan. 1, 1891, between Lexington and Lott, 15 miles. Under construction between Lexington and Lott, 50 miles. San Antonio & Tampico R. R.—Surveyed, Alice to Monterey, Mex., 230 miles.

69. ***Sherman, Denison & Dallas.***—Track laid in 1890, Sherman to Denison, 9.53 miles. Projected, Sherman to Dallas, 80 miles.

Velasco Terminal.—Under construction, Velasco to Arcola, 60 miles. President, O. B. Farwell, Chicago. Chief Engineer, C. C Campbell, Velasco.

70. ***Weatherford, Mineral Wells & Northwestern.***—Track laid in 1890, Weatherford to Mineral Wells, 23 miles.

71. ***Waco, Lampasas & Llano.***—Under construction, Llano to Lampasas, 40 miles. Surveyed, Lampasas to Waco, 100 miles. Chief Engineer, C. A. Gilchrist, Waco.

72. ***Wichita Valley.***—Track laid in 1890, Wichita Falls to Seymour, 51 miles.

Projects and Surveys.

73. ***Anson & Abilene.***—Projected, Anson to Abilene, 28 miles. H. A. McEachen, Abilene.

Beeville, Legarto & Rio Grande.—Projected, Beeville to San Diego, 160 miles. President, H. B. Newberry, Legarto.

74. ***Corsicana & Southeastern.***—Surveyed, Corsicana to International & Great Northern Ry, 50 miles. President, Chas. H. Allyn, Corsicana.

Georgetown & Granger.—Located, Granger to Georgetown, 15 miles. President, Emzy Taylor, Georgetown. Chief Engineer, J. O'Neill, Bullinger.

Houston & Brazos River.—Projected, Houston to Velasco, 60 miles. S. Taliaferro, Houston.

San Antonio & Oakville.—Projected, San Antonio to Oakville, 80 miles. S. J. Whitcett, San Antonio.

75. ***Sherman & Northeastern.***—Surveyed, Sherman to Ardmore, 50.5 miles. President, W. A. Thomas, Wichita, Kan.

South Galveston & Gulf Shore.—Projected, Galveston to South Galveston, 20 miles. President, M. F. Mott, Galveston.

Tayler, Bryan & Eastern.—Projected, Tayler to Trinity, 135 miles. F. M. Mundane, Lexington.

Trinity, Cameron & Western.—Projected, Trinity to Granger, 113 miles. President, J. M. Hefly; Secretary, M. J. Moore; both of Trinity.

Total.—Track laid in 1890, 220.8 miles. Track laid since Jan. 1, 1891, 65 miles. In process of construction, 431 miles. Located or under survey, 905 miles. Projects of some promise, 1,146 miles.

ILLINOIS—Existing Roads.

(Lines within limits of map only.)

76. ***Belleville & St. Louis.***—Under contract, East St. Louis to Belleville, 13.5 miles. President, Wm. A. Adams; Chief Engineer, Wm. A. Reis; both of St. Louis.

77. ***Centralia & Chester.***—Track laid in 1890, Coulterville to Oakdale, 8 miles. Track laid since Jan. 1, 1891, Oakdale to Nashville, 8 miles. Under construction, Nashville to Centerville, 16 miles. Surveyed, Nashville to Altamont, 95 miles; Sparta to Chester, 20 miles.

78. ***Chicago & New Orleans.***—Under construction, Farina to Paducah, 130 miles. Surveyed, Farina to Shelbyville, 40 miles. Chief Engineer, C. P. Moore, Farina.

79. ***Chicago, Peoria & St. Louis.***—Track laid in 1890, Littlefield to East St. Louis, 48 miles.

80. ***Louisville, Evansville & St. Louis.***—Track laid in 1890, Belleville to Centralia, 48.7 miles.

81. ***Ohio & Mississippi.***—Located, Cypress Junction to Paducah, 54 miles.

82. ***St. Louis, Alton & Terre Haute.***—Track laid in 1890, Lock Haven to Elsa, 6.3 miles.

83. ***St. Louis, Chester & Grand Tower.***—Under contract. East St. Louis to Grand Tower, 65 miles. Chief Engineer, Clinton F. Stephens, East St. Louis.

Total.—Track laid in 1890, 111 miles. Track laid since Jan. 1, 1891, eight miles. In process of construction, 274 miles. Located and under survey, 260 miles.

Standard Rail and Splice Bars; New York, New Haven & Hartford R. R.

We illustrate this week the standard section of rail and form of splice bars and joint adopted in January, 1889, by the New York, New Haven & Hartford R. R. A considerable amount of track is already laid to this standard, and the same is now being laid on the four-track work in progress between South Norwalk and Bridgeport, Conn. We are indebted to Mr. F. S. CURTIS, Chief Engineer, for blue prints from which the cuts are prepared.

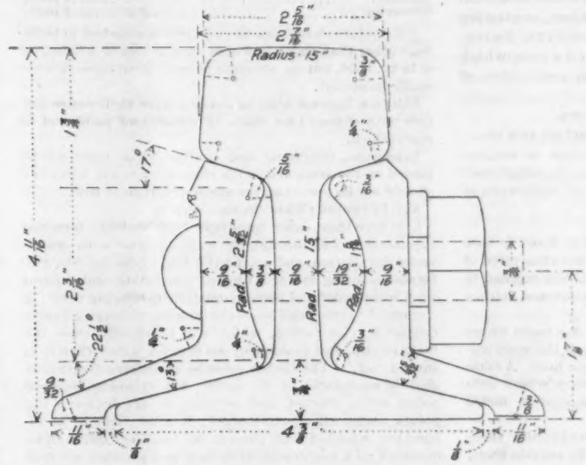
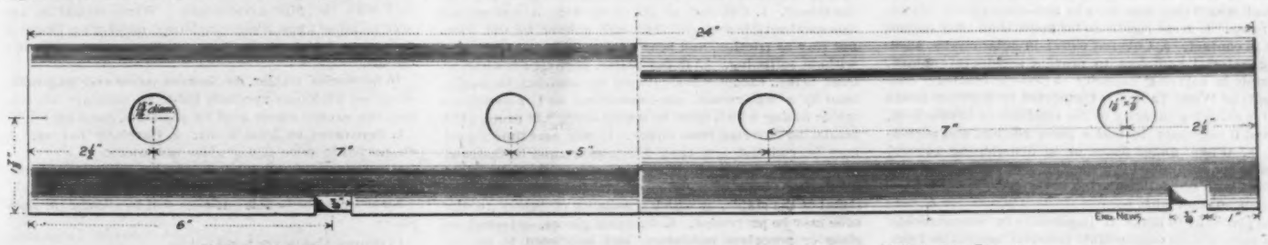


Fig. 1. Section of Standard Rail and Joint; New York, New Haven & Hartford R. R.

The rail weighs 73.66 lbs. per yd., and has slightly flaring sides to the head. The edges of the flanges are rounded. The dimensions are as follows:

	Ins.
Height	4 1/16
Width of base	4 3/4
Width of head at top	2 3/16
Width of head at bottom	2 1/4
Depth of head	1 3/4
Height of web	2 3/16
Depth of flange	3/4
Thickness of web	7/16
Height from base to center of bolt holes	1 7/8
Radius of top of head	15
" " top corners of head	3/16
" " bottom corners of head	1/4
" " top fillets	1/4
" " bottom fillets	1/4
" " sides of web	15
" " top corners of base	1/16
" " bottom corners of base	1/16
Fishing angle of head	17°
" " base	13°

The rails are laid with broken joints. The joints are suspended and are spliced by angle bars 24 ins. long with four bolts. The clear space between joint ties is about 8 ins. The angle splice bars are shown in section in Fig. 1, and in elevation in Fig. 2. As will be seen by Fig. 1, the two bars are of different sections, with deep curves to the inner faces. It would seem a better plan to make these bars of symmetrical section, to bring them closer in to the web of the rail, and to increase the depth of the upper part, somewhat after the section of the Baltimore & Ohio R. R. splice bars for 85-lb. rails illustrated in ENGINEERING NEWS, July 18, in order to give a better wearing quality to the bearing surface of the bar. The middle bolts are spaced 5 ins. c. to c., and the outer ones 7 ins. c. to c. Both bars are notched for spikes. The bolt holes in the rail are 1 1/8-ins. diameter; those in the outer splice bar are 1 1/8 in. in diameter, and those in the inner splice bar are oval, 1 1/4 × 7/8 in. The bolts are 7/8-in. diameter and have cup heads. The nuts are square and are on the outer side of the track. Spring washers are interposed between the nuts and splice bar. The rails are manufactured by the Lackawanna Iron & Coal Co., of Scranton, Pa. The ties are of oak and chestnut, 8 ft. long, 6 ins. thick and 6 to 9 or 10 ins. wide on the face. Some are hewn and others are sawn on two sides. On new track there are 18 ties to a rail length, and the ballast is of broken stone. The improved Servis tie plates, 8 1/2 × 6 ins., with 3 ribs or flanges, are used, but in some cases are omitted on the joint ties. The method of laying these plates is as follows:



Half Outside Elevation. Half Inside Elevation.

FIG. 2. STANDARD SPLICE BARS; N. Y. N. H. & H. R. R.

The ties are distributed on the subgrade, lined up, and a chalk line struck across at a certain distance from one end. A plate is then laid on each tie with the outer edge against this line, and the flanges are driven into the ties by hammering the plate with a long handled wooden mallet, the edges of which are hooped with iron. Then a plate is laid at the other end of the tie, and put in place by a gage consisting of a wooden rod, with two square lugs to fit into the spike holes of the plates. The driving of the plates is not done carefully, and the result is that in several case the plates are bent at the middle or at one side, so as to make an uneven seat for the rail, as noted in some places on the tracks now in service. The proper plan, as adopted in laying these plates on the Boston & Albany R.R. (ENGINEERING NEWS, April 4, 1891), is to lay a wooden block on the plate to distribute the force of the blow of the mallet, and so prevent bending.

On some parts of the older track the former style of joint, with the top of the outer splice bar projecting up against the side of the rail head, is still in use. There are also some Weber joints, near East Norwalk (ENGINEERING NEWS, Dec. 20, 1890). The nut locks in use include the Davies, Jones (ENGINEERING NEWS, June 1 and June 29, 1889), single and double Excelsior and Verona. Bridge ties are 8 × 6 ins., space 7 1/2 to 8 ins. clear. Guard rails consist of outside timber guards 8 × 6 ins., boxed out over the the ties and bolted; they are 15 ins. clear from the rail, and 10 1/2 ins. clear on new work. Inside iron guard rails are also used, and are extended well on to the embankment on the approach side. Some long bridges, like the one at Norwalk, have both guards, the wooden ones 10 1/2 ins. and the iron ones 8 ins. from the track rail. Such bridges also have the rails fastened to some of the ties by the Bush inter locking bolts. (ENGINEERING NEWS, Dec. 20, 1890).

This road has already a considerable amount of four track line in use on the New York division, and it is expected that the four track work between South Norwalk and Bridgeport, Conn., 12 miles, and the half-mile at Port Chester, N. Y., will be completed this fall, as well as the double tracking of the Shore Line division between New London and Leete's Island, Conn., 38 miles.

Steam Boiler Notes.

At the recent annual meeting of the Manchester Steam Users' Association it was stated that another year had passed with no failures among the boilers insured in the association. During the year, however, there were 35 deaths and 74 injuries in Great Britain by explosions of boilers and other steam vessels. A bill to make the inspection of steam boilers compulsory is to be introduced into Parliament at the next session and the chances for its passage are considered good.

The majority of Lancashire boilers made under the inspection of the association during the year were 8 ft. in diameter with 3 ft. 3 ins. in the furnaces and a length of 30 ft. It is recommended that with furnaces of this size the length of the boiler be increased 3 ft. The working pressures of these boilers were 100 to 125 lbs., and boilers of this type of 6 ins. smaller diameter carried pressures as high as 180 lbs.

One member of the association reports a gain in fuel economy of about 13% by the substitution of one large boiler in place of two small ones.

The following recommendations for smoke prevention are made for the benefit of those who cannot go to the expense of mechanical strokers:

Adopt the system of alternate side firing introduced several years ago by CHARLES WYE WILLIAMS. Instead of scattering the coal at random all over the fire at every charge, throw it to one side only, to the left-hand side at one charge, leaving the right hand side bright, and to the right hand side at the next charge, leaving the left-hand side bright. After each charge open the ventilators in the fire doors, so as to admit a little air above the fire bars, till the smoke is burnt off. By no means fire in large, heavy charges, but fire *regularly and lightly.* Do not rouse the fire with a rake. The use of the rake is the enemy of smoke prevention. Be sure and keep the bars covered at the back.

All boilers made to the standard specifications of the association have a sliding grid outside and a perforated box baffle-plate inside, the total cross-section of the air passages being nearly 50 sq. ins. "Split bridges" and "hanging bridges" are also

recommended as efficient aids in the prevention of smoke.

"Live firebars," which are automatically kept in constant motion, have been introduced for burning slack and other cheap grades of fuel, and have given excellent satisfaction.

Rules for the Safe Installation of Electric Light and Power Plants.

In our issue of Aug. 9, 1890, we published the code of regulations adopted by the Manufacturers' Mutual Insurance Co., of Boston, for the safe installation of electric light and power plants. The subject of a standard code of rules for safe wiring has for some time been under consideration by the National Electric Light Association. At the recent Montreal Convention, a committee on this subject, consisting of Messrs. WM. MCDEVITT, T. CARPENTER SMITH, WM. BROPHY and M. D. LAW reported a code which was considered by the convention in committee of the whole and was finally adopted.

We publish the code in full as follows:

CLASS A.—CENTRAL STATIONS, FOR LIGHT OR POWER.

(These rules also apply to dynamo rooms in isolated plants, connected with or detached from buildings used for other purposes. Also to all varieties of apparatus, of both high and low potential.)

GENERATORS OR MOTORS must be:

1. Located in a dry place. 2. Insulated on floors or base frames, which must be kept filled to prevent absorption of moisture, and also kept clean and dry. 3. Not exposed to flying or combustible materials. 4. Each covered with a waterproof cover when not operating.

In no case must a generator be placed in a room where any hazardous process is carried on, such as the working-room of a cotton, jute, flax, woolen or flour mill. A competent man must be kept on duty in the room where generators are operating. Oily waste must be kept in metal cans and removed daily.

CONDUCTORS.—From generators, switchboards, rheostats or other instruments, and thence to outside lines, conductors must be: 1. In plain sight. 2. Wholly on non-combustible insulators, such as glass or porcelain. 3. Separated from contact with floors, partitions or walls through which they may pass by non-combustible insulating tubes. 4. Kept rigidly so far apart that they cannot come in contact. 5. Covered with non-inflammable insulating material sufficient to prevent accidental contact. 6. Ample in carrying capacity to prevent heating. (See Capacity of Wires Table.) 7. Connected by splices or joints equal in carrying capacity to the conductors themselves, soldered if necessary to make them efficient and permanent. 8. When under floors or in distributing towers, placed in spaces ample for inspection and ventilation, and provided with special insulating covering.

SWITCHBOARDS must be:

1. So placed as to make it impossible to communicate fire to surrounding combustible material; accessible from all sides when the connections are on the back; or may be placed against a brick or stone wall when the connections are entirely on the face. 2. Kept free from moisture. 3. Made of non-combustible material, or of hard wood, filled to prevent absorption of moisture. 4. Equipped with bars and wires in accordance with Rules 1, 2, 4, 5, 6 and 7 for placing inferior conductors.

RESISTANCE BOXES AND EQUALIZERS must be:

1. Equipped with metal or non-combustible frames. 2. Treated as sources of heat. 3. Placed on the switch or a distance of a foot from combustible material, or separated therefrom by asbestos or cement.

LIGHTNING ARRESTERS must be:

1. Attached to each side of every overhead circuit connected with the station. 2. In plain sight. 3. On the switchboard, or in an equally accessible place, away from combustible material. 4. Connected with at least two earths by separate wires of large size. 5. So constructed as not to maintain an arc after the discharge has passed.

TESTING.—All series and alternating circuits must be tested every two hours while in operation to discover any leakage to earth, abnormal in view of the potential and method of operation.

All multiple arc low potential systems (300 volts or less,) must be provided with an indicating or detecting device, readily attachable, to afford easy means of testing where the station operates perpetually.

Data obtained from all tests must be preserved for examination by insurance inspectors.

CLASS B.—ARC (SERIES) SYSTEMS.

OVERHEAD CONDUCTORS.—All outside overhead conductors (including services) must be:

1. Covered with some insulating material not easily abraded. 2. Firmly secured to properly insulated and substantially built supports, all the wires having an insulation equal to that of the conductors they confine. 3. So placed that moisture cannot form a cross connection between them, not less than a foot apart and not in contact with any substance other than proper insulating supports. 4. At least 7 ft. above the highest point of flat roofs and at least 1 ft. above the ridge of pitched roofs, over which they pass or to which they are attached. 5. Protected whenever necessary, in view of possible accident to conductors or supports, from possibility of contact with other conducting wires or substances to which current may leak, by *dead insulated guard irons or wires.* Special precautions of this kind must be taken where sharp angles occur, or where any wires might possibly come in contact with electric light or power wires. 6. Provided with petticoat insulators of glass or porcelain. Porcelain knobs and rubber hooks are prohibited. 7. So spliced or joined as to be both mechanically and electrically secure without solder. They must then be soldered to insure preservation and covered with an insulation equal to that on the conductors. The following formula for soldering fluid is approved:

Saturated solution of zinc	5 parts.
Alcohol	4 parts.
Glycerine	1 part.

Conductors should not be run over or attached to buildings other than those in which light or power is being, or is to be, used, but on separate poles or structures, always easily inspected.

SERVICE BLOCKS must be covered over their entire surface with at least two coats of waterproof paint and so maintained.

Telegraph, telephone and similar wires must not be placed on the same arm with electric or power wires and *should not* be placed on the same structure or pole.

ALL INTERIOR CONDUCTORS—Must be:

1. Where they enter buildings from outside terminal insulators to and through the walls covered with waterproof installation, and must have drip loops outside, preferably slanting upward toward the inside, and bushed with waterproof and non-combustible insulating tube. 2. Arranged to enter and leave the building through a double contact service switch, which will effectually close the main circuit, and disconnect the interior wires when it is turned "off." The switch must be so constructed that it shall be automatic in its action, not stopping between points when started, and prevent an arc between the points under all circumstances; it must indicate on inspection whether the current be "on" or "off," and be mounted on a non-combustible base in a position where it can be kept free from moisture, and easy of access to police or firemen. 3. Always in plain sight, never covered, except in special cases, when an armored tube may be necessary. 4. Covered in all cases with a waterproof non-combustible material that will adhere to the wire, not fray by friction, and bear a temperature of 150° Fahr. without softening. 5. In dry places, kept rigidly apart at least 10 ins., except when covered (in addition to insulation) by a waterproof, non-conducting and non-inflammable tubing which must be strong enough to protect the insulating covering from injury. Conductors thus placed may be run not less than 3 ins. apart, and be fastened with staples, under which are placed mechanically rigid insulating strips or saddles of greater width than the metal of the staple, by which possibility of injury to the tube may be prevented. 6. In damp places, attached to glass or porcelain insulators, and separated 10 ins. or more. 7. When passing through walls, floors, timbers or partitions, treated as in central stations under like conditions.

ARC LAMPS must be:

1. Carefully isolated from inflammable material. 2. Provided at all times with a glass globe surrounding the arc, securely fastened upon a closed base. No broken or cracked globes may be used. 3. Provided with a hand switch, also an automatic switch that will shunt the current around the carbons should they fail to feed properly. 4. Provided with reliable stops to prevent carbons from falling out in case the clamps become loose. 5. Carefully insulated from the circuit in all their exposed parts. 6. Where inflammable material is near or under the lamps, provided with a wire netting around the globe and a spark arrester above, to prevent escape of sparks, melted copper or carbon.

INCANDESCENT LAMPS in series circuits, having a maximum potential of 350 volts or over, must be governed by the same rules as for arc lights, and each series lamp provided with a hand switch and automatic cut-out switch; when lights are in multiple series, such switches and cut-outs must not control less than a single group of lights. Electromagnetic devices for switches are not approved. Under no circumstances will incandescent lamps on series circuits be allowed to be attached to gas fixtures.

CLASS C.—INCANDESCENT (LOW PRESSURE) SYSTEMS. (300 volts or less.)

OUTSIDE OVERHEAD CONDUCTORS must be:

1. Erected in accordance with general rules for arc (series) circuit conductors. 2. Separated not less than 6 ins. where they enter buildings as service conductors, and be provided with a double pole fusible cut-out, as near as possible to the point of entrance to the building, and outside the walls when practicable.

UNDERGROUND CONDUCTORS must be:

1. Provided with suitable protecting devices at the ends of tube or conduit services inside the walls of buildings, as a guard against moisture and injury. 2. Terminated at a properly placed double pole house cut-out. 3. Of specially insulated conductors after leaving the tube or conduit, and separated at least 10 ins., until the double pole cut-out is reached.

Inside wiring should be so placed that in the event of the failure or deterioration of their insulating covering the conductors will still remain insulated. At the entrance of every building there shall be a double pole switch placed in the service conductors, whereby the current may be cut off.

CONDUCTORS must not be:

1. Of sizes smaller than No. 16 B. & S., No. 18 B. W. G., or No. 3 E. S. G. 2. Lead or paraffine covered. 3. Covered with soft rubber tube. 4. Laid in moldings of any kind in damp places. 5. Laid in moldings with open grooves against the wall or ceiling. 6. Laid in moldings where less than half an inch of solid insulation is between parallel wire, and between wires and walls or ceilings.

CLEATWORK is not desirable, and cleats must *not* be used unless:

1. In a very dry place. 2. In a place perfectly open for inspection at any time. 3. They are of porcelain, or well seasoned wood, filled, to prevent absorption of moisture. 4. They are so arranged that wires of opposite polarity, with a difference of potential of 150 volts or less, will be kept at least 2½ ins. apart and that where a higher voltage is used, this distance be increased proportionately. 5. There is a backing provided, of wood at least half an inch thick, well seasoned and filled, to prevent absorption of moisture.

METAL STAPLES must never be used to fasten conductors unless:

1. Provided with an insulating sleeve or saddle rigidly attached to the metal of the staple, and having such strength and surface as to prevent mechanical injury to the insulation of the conductor. 2. Under conditions in which cleatwork would be acceptable or where driven into a molding specially adapted for open work.

SPECIAL WIRING.—Wherever conductors cross gas, water or other metallic pipes, or any other conductors or conducting material (except arc light wires), they should be separated therefrom by some continuous non-conductor at least 1 in. In crossing arc light wires the low tension conductors must be placed at a distance of at least 6 ins. In wet places an air space must be left between conductors and pipes in crossing, and the former must be run in such a way that they cannot come in contact with the pipe accidentally. Wires should be run *over* all pipes upon which condensed moisture is likely to gather, or which by leakage might cause trouble on a circuit.

In breweries, stables, dye-houses, paper and pulp mills, or other buildings specially liable to moisture, all conductors, except where used for pendants, must be:

1. Separated at least 6 ins. 2. Carefully put up. 3. Supported by porcelain or glass insulators.

Moisture-proof and non-inflammable tubing may be accepted in lieu of such construction.

No switches or fusible cut-outs will be allowed in such places.

INTERIOR CONDUITS must not be:

1. Combustible. 2. Of such material as will be injured or destroyed by plaster or cement, or of such material as will injure the insulation of the conductor, or construction that the insulation of the conductor will ultimately be injured or destroyed by the elements of the composition. 3. So constructed or placed that difficulty will be experienced in removing or replacing the conductors. 4. Subject to mechanical injury by saws, chisels or nails. 5. Supplied with a twin conductor in a single tube where a current of more than 10 ampères is expected. 6. Depended upon for insulation. The conductors must be covered with moisture-proof material.

The object of a tube or conduit is to facilitate the insertion or extraction of the conductors, to protect them from mechanical injury and as far as possible from moisture.

Twin tube conductors must not be separated from each other by rubber or similar material, but by cotton or other readily carbonizable substance.

Conductors passing through walls or ceilings must be incased in a suitable tubing, which must extend at least 1 in. beyond the finished surface until the mortar or other similar material be entirely dry, when the projection may be reduced to ½ in.

DOUBLE POLE SAFETY CUT-OUTS must be:

1. Placed where the overhead or underground conductors enter a building and join the inside wires. 2. Placed at every point where a change is made in the size of the wire (unless the cut-out in the large wire will protect the smaller). This includes all flexible conductors. All such junctions must be in plain sight. 3. Constructed with bases of non-combustible and moistureproof material. 4. So constructed and placed that an arc cannot be maintained between the terminals by the fusing of the metal. 5 So placed that any combination fixture, or group of lamps requiring a current of six amperes or more shall be ultimately dependent upon one cut-out. 6. Wherever used for more than six amperes (or where the plug or equivalent device is not used) equipped with fusible strips or wires provided with contact surfaces or tips of harder

metal soldered or otherwise having perfect electrical connection with the fusible part of the strip.

SAFETY FUSES must be so proportioned to the conductors they are intended to protect that they will melt before the maximum safe carrying capacity of the wire is exceeded.

All fuses, where possible, must be stamped or otherwise marked with the number of amperes equal to the safe carrying capacity of the wire they protect.

All cut-out blocks when installed must be similarly marked.

The safe carrying capacity of a wire changes under different circumstances, being about 40% less when the wire is closed in a tube or piece or moulding than when bare and exposed to the air, when the heat is rapidly radiated. It must be clearly understood that the size of the fuse depends upon the size of the smallest conductor it protects, and not upon the amount of current to be used on the circuit. Below is a table showing the safe carrying capacity of conductors of different sizes in Birmingham, Brown & Sharpe, and Edison gages, which must be followed in the placing of interior conductors.

Brown & Sharpe Gage No.	Amperes.	Birmingham Gage No.	Amperes.	Edison Stand'rd Gage No.	Amperes.
0000	175	0000	175	200	175
000	145	000	150	180	160
00	120	00	130	140	135
0	100	0	110	110	110
1	95	1	95	90	95
2	70	2	85	80	85
3	60	3	75	65	75
4	50	4	65	55	65
5	45	5	60	50	60
6	35	6	50	40	50
7	30	7	45	30	40
8	24	8	35	25	35
10	20	10	30	20	30
12	15	12	20	12	20
14	10	14	15	8	15
16	5	16	10	5	10
		18	5	3	5

SWITCHES must be:

1. Mounted on moisture proof and incombustible bases, such as slate or porcelain. 2. Double pole when the circuits which they control are connected to fixtures attached to gas pipes, and when six ampères or more are to pass through them. 3. Have a firm and secure contact, must make and break readily, and not stick when motion has once been imparted by the handle. 4. Have carrying capacity sufficient to prevent heating above the surrounding atmosphere. 5. Be placed in dry accessible places, and be grouped as far as possible, being mounted, when practicable, upon slate or equally indestructible backboards.

MOTORS.—In wiring for motive power, the same precautions must be taken as with the current of the same volume and potential for lighting. The motor and resistance box must be protected by a double pole cut-out controlled by a double pole switch.

ARC LIGHTS ON LOW POTENTIAL CIRCUITS must be:

1. Supplied by branch conductors not smaller than No. 12 B. & S. gage. 2. Connected with main conductors only through double pole cut-outs. 3. Only furnished with such resistances or regulators as are enclosed in non-combustible material, such resistances being treated as sources of heat. 4. Supplied with globes protected as in the case of arc lights on high potential circuits.

FIXTURE WORK.—1. In all cases where conductors are concealed within or attached to fixtures, the latter must be insulated from the gas-pipe system of the building. 2. When wired outside, the conductors must be so secured as not to be cut or abraded by the pressure of the fastenings, or motion of the fixtures. 3. All conductors for fixture work must have a water-proof insulation that is durable and not easily abraded, and must not in any case be smaller than No. 16 B. & S., No. 18 B. W. G., or No. 3 E. S. G. 4. All burs or fins must be removed before the conductors are drawn into a fixture. 5. The tendency to condensation within the pipes must be guarded against by sealing the upper end of the fixture. 6. No combination fixture in which the conductors are concealed in a space less than one-fourth inch between the inside pipe and the outside casing will be approved. 7. Each fixture must be tested for possible "contacts" between conductors and fixture, and for "short circuits," before the fixture is connected to its supply conductors. 8. The ceiling blocks of fixtures should be made of insulating material.

ELECTRIC GASLIGHTING.—Where electric gaslighting is to be used on the same fixture with the electric light:

1. No part of the gas piping or fixture shall be in electrical connection with the gaslighting circuit. 2. The wires used with the fixture must have a non-inflammable insulation, or where concealed between the pipe and shell of the fixture the insulation must be such as is required for fixture wiring for the electric light. 3. The whole installation must test free from "grounds." 4. The two installations must test perfectly free of connection with each other.

PENDANTS AND SOCKETS.—No portion of the lamp socket exposed to contact with outside objects must be allowed to come into electrical contact with either of the conductors.

CORD PENDANTS must be:

1. Made of conductors, each of which is composed of several strands insulated from the other conductor by a mechanical separator of carbonized material, and both surrounded in damp places with a moisture-proof and a non-inflammable layer. 2. Protected by insulating bushings where the cord enters the socket. 3. So suspended that the entire weight of the socket and lamp will be borne by knots above the point where the cord comes through the ceiling block or rosette, in order that the strain may be taken from the joints and binding screws. All sockets used for wire or cord pendants should have openings at least equal to one-quarter inch gas pipe size. 4. Allowed to sustain nothing heavier than a four-light cluster, and in such a case special provision should be made by an extra heavy cord or wire as a mechanical reinforcement. 5. Equipped with keyless sockets as far as practicable, controlled by wall switches. In no case may a lamp giving more than fifty (50) candle power be placed in a key socket on a flexible pendant.

CLASS D.—ALTERNATING SYSTEMS.

CONVERTERS OR TRANSFORMERS must not be:

1. Placed inside of any building except the central station, unless as hereinafter provided. 2. Be placed in any but metallic or non-combustible cases. 3. Be attached to the outside walls of buildings, unless separated therefrom by substantial insulating supports. 4. Be placed in any other than a dry and convenient location (which can be secured from opening into the interior of the building such as a vault) when an underground service is used. 5. Be placed without safety fuses at the junction between main and service conductors and safety fuses in the secondary circuits where they will not be affected by the heat of the converter.

PRIMARY CONDUCTORS.—In those cases where it may not be possible to exclude the transformers and primary wires entirely from the building, the following precautions must be strictly observed:

1. The transformer must be located at a point as near as possible to that at which the primary wires enter the building. 2. Between these points the conductors must be heavily insulated with a coating of moisture-proof material, and, in addition, must be so covered and protected that mechanical injury to them or contact with them shall be practically impossible. 3. The primary conductors, if within a building, must be furnished with a double pole switch, and also with an automatic double pole cut-out where the wires enter the building, or where they leave the main line, on the pole or in the conduit. These switches should, if possible, be inclosed in secure and fireproof boxes outside the building. 4. The primary conductors, when inside a building, must be kept apart at least 10 ins., and at the same distance from all conducting bodies.

SECONDARY CONDUCTORS.—The conductors from the secondary coil of the transformer to the lamps or other translating devices must be installed according to the rules for "inside wiring" for "low potential systems."

CLASS E.—ELECTRIC RAILWAYS.

POWER STATIONS.—All rules pertaining to arc light wires and stations shall apply (so far as practicable) to street railway power stations and their conductors.

RAILWAY SYSTEMS WITH GROUND RETURN.—Electric railway systems in which the motor cars are driven by a current from a single wire, with ground or floor return circuit, are prohibited *except* as hereinafter provided:

1. When there is no liability of other conductors coming in contract with the trolley wire. 2. When the location of the generator is such that the ground circuit will not create a fire hazard to the property. 3. When an approved automatic circuit breaker or other device that will immediately cut off the current in case the trolley wires become grounded is introduced in each circuit as it leaves the power station. This device must be mounted on a fireproof base and be in full view of the attendant.

TROLLEY WIRES—Must be:

1. No smaller than No. 0 B. & S. copper, or No. 4 B. & S. silicon bronze, and must readily stand the strain put upon them when in use. 2. Well insulated from their supports, and in case of the side or double pole construction, the supports shall also be insulated from the poles immediately outside the trolley wire. 3. Capable of being disconnected at the power-house, or of being divided into sections, so that in case of fire on the railway route the current may be shut off from the particular section and not interfere with the work of the firemen in extinguishing the flames. This rule also applies to feeders. 4. Safely protected against contact with all other conductors.

CAR WIRING.—All wires in cars must be run out of reach of the passengers, and shall be insulated with a waterproof insulation.

LIGHTING AND RAILWAY POWER WIRES.—Lighting and power wires must not be permitted in the same circuit with trolley wires with a ground return, except in street railway cars, carhouses and power stations. The same dynamo may be used for both purposes, provided the connection from the dynamo for each circuit shall be a double pole switch so arranged that only one of the circuits can be in use at the same time.

CLASS F.—BATTERIES.

When current for light and power is taken from primary or secondary batteries, the same general regulations must be observed as apply to such wires fed from dynamo generators developing the same difference of potential.

CLASS G.—MISCELLANEOUS.

1. The wiring in any building must test free from "grounds" before the current is turned on. This test may be made with a magnet bell that will ring through a resistance of 20,000 ohms, where currents of less than 250 volts are used. 2. No ground wires for lightning arresters may be attached to gas pipes within the building. 3. All conductors connecting with telephone, district messenger, burglar alarm, watch clock, electric time and other similar instruments must, if in any portion of their length they are liable to become crossed with circuits carrying currents for light or power, be provided near the point of entrance to the building with some protective device which will operate to shunt the instruments in case of a dangerous rise of potential, and will open the circuit and arrest an abnormal current flow. Any conductor normally forming an innocuous circuit may become a source of fire hazard if crossed with another conductor through which it may become charged with a relatively high pressure.

The committee also recommended a permanent committee of five members to be appointed by the President to report at each meeting of the association their opinion on any questions which may have arisen since the preceding meeting.

The Rain-Making Experiments in Texas.

As we have noted in reviewing the October magazines, the leading article in the *North American Review* is a dual paper by Gen. R. G. DYRENFORTH and Prof. SIMON NEWCOMB, on the possibilities of "rain making." Gen. DYRENFORTH's theories of "cloud compelling" are that an equatorial air current flows over the arid plains of the Southwest, and may be deflected by artificial means and cooled by mixture with cooler currents at a higher altitude. Also that the concussion due to explosions may cause rain to fall by jarring together particles of moisture held in suspension in the clouds.

It will be remembered that in our issue of Sept. 5 Mr. WM. E. MERRILL pointed out that the idea that rainstorms followed great battles antedated the days of gunpowder. But Gen. DYRENFORTH is aware of this fact. He says:

> Let ten thousand Greeks march into battle chanting their "pæans" and shouting their "allallas," beating meanwhile on their shields, while a hundred thousand Persians are advancing against them continually shouting their terrible battle-cries; then let the great armies rush together with the tumult of clashing swords and shields, the fierce shouting of the multitudes, the hoarse death-cries and shouts of victory, and surely the sound waves rising from such a din will literally shake the heavens, and are capable of producing no insignificant effect among the volatile currents of the upper air. Moreover, the heat generated from the struggling masses and the moisture evaporated from their perspiration would exercise a decided influence in disturbing the equilibrium of the atmospheric conditions.

After quoting from POWER's "War and the Weather" in support of his theories, Gen. DYRENFORTH describes at length the recent experiments in Texas. Briefly the explosives used during the 16 days of the experiments were one ton of rackarock and dynamite and the oxyhydrogen gas produced from two tons of iron borings, one ton of sulphuric acid and ¼ ton of chlorate of potash and binoxide of manganese. During these 16 days Gen. DYRENFORTH states that 3 heavy rainstorms and 9 small showers occurred. In the first rainstorm nearly 2 ins. of water fell; the second "fell in torrents" for 2½ hours; and the third, of similar violence, lasted for 4 hours, and extended over many hundreds of square miles. In the opinion of Gen. DYRENFORTH the experiments clearly demonstrate:

First. That the concussions from explosions exert a marked and practical effect upon the atmospheric conditions in producing or occasioning rainfall, probably by disturbing the upper currents.

Second. That when the atmosphere is in a "threatening" condition—which is frequently the case in most arid regions without any rain resulting—rain can be caused to fall almost immediately by jarring together the particles of moisture which hang in suspension in the air. This result was repeatedly effected during our operations, the drops sometimes commencing to fall within twelve seconds from the moment of the initial explosion.

It also seems probable that the immense amount of frictional electricity generated by the concussions and the mingling of opposing currents of air may have considerable influence in the formation of storm centers by producing a polarized condition of the earth and air, and so creating a magnetic field which may assist in gathering and so condensing the moisture of the surrounding atmosphere.

Altogether, considering the great difficulties under which we labored, the results of our first experiments have been exceedingly gratifying and encouraging to the advocates of the theory that rain can be produced at will by artificial means, and the further tests of the theory which will soon be made at El Paso, Texas, will be watched with great interest.

Prof. NEWCOMB's argument is short and to the point. He says: "I am not going to maintain that we can never make it rain; but I do maintain that if we are ever going to make it rain or produce any other result hitherto unattainable, we must employ adequate means, also that if any proposed means or agency is already familiar to science, we may be able to decide beforehand whether it is adequate."

He then describes the process of formation of clouds, by condensation of atmospheric moisture due to cooling, and says that in order to produce rain moisture in the atmosphere must first be condensed and then collected in the form of drops. Continuing, he says:

Now let us consider sound as an agent for changing the state of things in the air. It is one of the commonest and simplest agencies in the world, which we can experiment upon without difficulty. It is purely mechanical in its action. When a bomb explodes, a certain quantity of gas, say five or six cubic yards, is suddenly produced. It pushes aside and compresses the surrounding air in all directions, and this motion and compression are transmitted from one portion of the air to another. The amount of motion diminishes as the square of the distance; a simple calculation shows that at a quarter of a mile from the point of explosion it would not be one ten-thousandth of an inch. The condensation is only momentary; it may last the hundredth or the thousandth of a second, according to the suddenness and violence of the explosion; then elasticity restores the air to its original condition and everything is just as it was before the explosion. A thousand detonations can produce no more effect upon the air, or upon the watery vapor in it, than a thousand rebounds of a small boy's rubber ball would produce upon a stone wall. So far as the compression of the air could produce even a momentary effect, it would be to prevent rather than to cause condensation of its vapor, because it is productive of heat which produces evaporation, not condensation. . . . But how, it may be asked, shall we deal with the fact that Mr. DYRENFORTH'S recent explosions of bombs under a clear sky in Texas were followed in a few hours, or a day or two, by rains in a region where rain was almost unknown? I know too little about the fact, if such it be, to do more than ask questions about it suggested by well-known scientific truths. If there is any scientific result which we can accept with confidence, it is that ten seconds after the sound of the last bomb died away, silence resumed her sway. From that moment everything in the air—humidity, temperature, pressure and motion—was exactly the same as if no bomb had been fired. Now, what went on during the hours that elapsed between the sound of the last bomb and the falling of the first drop of rain? Did the aqueous vapor already in the surrounding air slowly condense into clouds and raindrops in defiance of physical laws? If not, the hours must have been occupied by the passage of a mass of thousands of cubic miles of warm, moist air coming from some other region to which the sound could not have extended. Or was Jupiter Pluvius awakened by the sound after two thousand years of slumber, and did the laws of nature become silent at his command? When we transcend what is scientifically possible, all suppositions are admissible, and we leave the reader to take his choice between these and any others he may choose to invent.

PERSONALS.

Mr. W. H. TOUT, of Toronto, has been appointed City Engineer of Guelph, Ont.

Mr. F. W. BLACKFORD has been appointed City Engineer at Butte, Mont., vice Mr. J. H. HARPER, resigned.

Mr. H. COOK, Trainmaster on the eastern division of the Lake Erie & Western R. R., has been appointed a Division Superintendent on the Southern Pacific Railway.

Mr. F. P. KING, formerly Superintendent of Construction of the Colorado Midland Ry., has been appointed General Manager of the Denver, Lakewood & Golden R. R.

Mr. T. R. GABEL, Assistant General Superintendent of the Atlantic & Pacific R. R., has been appointed General Superintendent, vice Mr. D. B. ROBINSON, resigned.

Mr. ARCHIBALD R. TAYLOR died at Pine Bush, N. Y., Sept. 28, aged 80 years. He was engaged on the original surveys for the Erie road, and is said to have made the surveys for the first railway out of Chicago.

Mr. ROBERT BAXTER has resigned his position as Western Superintendent of the Baltimore & Ohio R. R., and will be appointed Superintendent of one of the Western Divisions of the Union Pacific.

Mr. J. M. GRAHAM, formerly Assistant General Superintendent of the Northern Pacific R. R., has been appointed to succeed Mr. BAXTER as Superintendent of the Ohio and Midland Divisions of the Baltimore & Ohio, with headquarters at Newark, O.

Mr. J. N. VAN WAGNER has not been appointed Superintendent of Bridges of the Hudson River Division of the New York Central & Hudson River R. R., as stated last week on the authority of a daily paper. A correspondent states the facts as follows: "Mr. VAN WAGNER never was Roadmaster of the Hudson River Division, but was Roadmaster of the Troy Union R. R., being the system of joint railways within the limits of the city of Troy, N. Y. He has, however, exchanged places with Mr. SNYDER, Superintendent of the two bridges across the Hudson River, over which the Hudson River R. R. Co. operates its passenger and freight business, which bridges are owned and operated by an independent company known as the Hudson River Bridge Co. Mr. VAN WAGNER takes Mr. SNYDER'S place, and Mr. SNYDER takes Mr. VAN WAGNER'S place."

Mr. HERMAN J. SCHWARZMAN, architect and engineer, died in New York last week, at the age of 45. He was a native of Bavaria, and came to this country in 1866. In 1868 he was appointed Assistant Engineer to the Fairmount Park Commissioners, Philadelphia. He was twice sent to Europe by the commission to study public parks, etc., and in 1873 was appointed Chief Engineer of the Centennial Grounds. His plans were adopted for Memorial and Horticultural Halls, and he also designed the Judges' Hall, the Women's Pavilion, Pennsylvania State Building, German and Brazilian Pavilions, and the annexes of the Main Building, the Art Gallery, the Photographic Exhibition Building, and the other smaller buildings on the grounds. After the Centennial he started business as an architect in Philadelphia, and opened an office in New York, to which city he moved in 1878.

NEW PUBLICATIONS.

October Magazines.—The series of articles on "The Development of American Industries Since Columbus," in *The Popular Science Monthly*, has for this month's installment the first part of a paper by Mr. WM. F. DURFEE, the well-known engineer, on the manufacture of steel. The editors made an excellent choice of an author to write upon this subject, Mr. DURFEE having had charge of the pioneer Bessemer steel plant of America. The first American steel maker of which any record exists was one JOHN TUCKER, of Southold, Long Island, who in 1655 petitioned the general court of Connecticut to grant him certain privileges in consideration of his "abilitie and intendment to make steele." There is no evidence, however, that his "abilitie and intendment" ever bore fruit, and not until 1725 is there any record of steel being produced. In that year one SAMUEL HIGLEY, of Connecticut, is said to have produced a few pieces of steel, on the strength of which a patent was granted him. After this date progress in what was then an obscure art was more rapid. Before the close of the century, it is stated that about one-half of the steel used in the United States was of home manufacture. So the author proceeds, describing the growth of the various processes, and telling very well that most interesting story of the invention and the progress of the Bessemer and open-hearth processes as well as the record of the now minor industries of crucible and cast steel manufacture. In "Lessons from the Census" CARROLL D. WRIGHT, United States Commissioner of Labor, begins a series of papers intended to discuss the important economic facts brought to light by the present census. It is not generally realized how far the new census exceeds in its scope any enumeration heretofore attempted. Its cost has already been nearly two million dollars in excess of that of the census of 1880, and another large appropriation will be required. Mr. WRIGHT shows that the apparently slow progress of the bureau in completing the census inquiries and compiling and publishing their results is due to the vast amount of work which the office has on hand. Another paper of special interest in the number is one by Dr. PATRICK on "The Rivalry of the Higher Senses," in which he argues that the tendency of modern life and of educational systems to train the eye, to the neglect of the senses of hearing and of such faculties as memory and perception, results in the deterioration of the latter powers. Prof. A. E. DOLBEAR discusses "Metamorphoses in Education," and shows what a complete revolution has been wrought in systems of education by the results of modern science. The following is so expressive that we quote it:

Our institutions of learning were all founded on theories of life, of mind, of society, of history, which have broken down. There is not a single one that has stood the test of modern science and disintegration set in some time back. It came first in a demand that colleges should furnish a knowledge of matters that books and periodicals were teeming with. . . . The new knowledge was not and could not be assimilated by the adherents of the old. Amalgamation to any extent was impossible and compromise was equally impossible, for the new has destroyed nearly everything of the foundations of the old then held to be true.

The most important article in *The Forum* to engineers is a paper on municipal government, or rather on "A Remedy for Municipal Misgovernment," by President C. W. ELIOT, of Harvard College.

The writer does not believe that popular depravity or unrestricted immigration are the chief causes of this great social evil. In a most acute analysis of the functions of city government he argues that the chief cause of the evils and abuses is the fact that a high grade of scientific and professional skill is needed to properly administer a city's finances and public works, to look after its drainage, water supply, street paving and cleaning, and the companies which supply it with heat, light, power, transportation and telegraphic or telephonic communication. He thinks it no exaggeration to say:

Good municipal administration has now become absolutely impossible without the employment, on permanent tenures, of a large number of highly trained and highly paid experts in various arts and sciences as directors of the chief city departments; and the whole question of municipal reform is covered by the inquiry, How can a city government be organized so as to secure the services of these experts?

Every engineer familiar with municipal affairs will say Amen to this; but the only way President ELIOT indicates for bringing about this reform is by increasing the term of office of the heads of city departments. But until city affairs are better managed than at present, there will be a popular outcry against the passage of laws increasing the term of office of present city officials, so it seems a long way ahead to the accomplishment of President ELIOT'S reform.

In a paper on the needs of our army and navy, Col. THEODORE A. DODGE estimates that it will only take about $500,000,000 to carry out the recommendations of the "Naval Policy Board" and the "Fortifications Board"! He tries to show that this expenditure is an advisable one, but he makes no mention of the possibilities that by the time this vast sum is expended the costly ironclads will be obsolete through the perfection of aerial or submarine methods of attack. The advantages of a naval militia and a reserve are set forth by Lieut.-Commander J. W. MILLER, of the N. Y. Naval Reserve Artillery.

The leading topic in the *North American Review* is: "Can we make it rain?" Gen. ROBERT G. DYRENFORTH, the manager of the recent "cloud compelling" expedition in Texas affirms that we can and says that he did. Prof. SIMON NEWCOMB writes in a temperate way to show that whether we can cause rain by artificial means or not, we cannot produce it by sound. We give elsewhere some extracts from the discussion.

In "New Life in China" Hon. JOHN RUSSELL YOUNG, late U. S. Minister to China, points out what sources of commercial wealth we are letting slip from our grasp by our cavalier treatment of the Chinese. He shows that China has strong reasons for granting to the United States privileges and opportunities for trade and commerce superior to those enjoyed by any European nation; but our policy toward the Celestial nation has destroyed our prestige, and the days of our great China trade are over.

LEWIS HERRESHOFF describes as well as possible without the aid of drawings the lines of the *Gloriana*, designed and built by N. G. HERRESHOFF this year, and quite an innovation on previous yacht models. He believes the principles on which the lines of the *Gloriana* have been laid down might be made use of to advantage in the design of ocean steamers. Discussing the evolution of the yacht, he declares that the *Mayflower*, *Puritan* and *Volunteer* are types of the best existing model for yachts, combining the good qualities of the American "skimming dish" with those of the British deep keel cutters.

Two other articles of interest are on "Reciprocity and Canada," by WM. HENRY HURLBERT, and a defense of the "orthodox" system of political economy, by one of the most prominent of the men who still adhere to it, E. L. GODKIN, of the New York *Evening Post*.

The only article of technical interest in this month's *Scribner's* is that on the Colorado desert lake, by Major POWELL, which we have reviewed elsewhere.

Harper's, too, is pretty closely confined to purely literary matter; MONTGOMERY SCHUYLER discusses the architecture of St. Paul and Minneapolis, and finds much to praise in their residences and "business blocks," and considerable to condemn in some of their public buildings. Of the bridges he says:

The site of St. Paul makes a bridge across the river at this point a very conspicuous object, and perhaps nowhere in the world would a noble and monumental bridge be more effective. The existing bridges, however, are works of the barest utility, apparently designed by railroad engineers with no thought of anything beyond efficiency and economy, and they are annoying interruptions to the panorama unrolled to the spectators from the hillside in the shining reach of the great river.

The *Atlantic* this month has an article on the late Sir JOHN MACDONALD which may interest some of our Canadian readers, also a keen analysis of the legal status of the American Indians, by JAMES B. THAYER. "The Cave Dwellers of the Confederacy" is an interesting description of the hiding places which were adopted by many of the dwellers in the mountainous regions of North Carolina

and Tennessee to avoid conscription in the Confederate Army.

The paper in *The Century* of greatest interest to engineers is MR. HIRAM S. MAXIM'S description of his now famous experiments in aerial navigation, which we have before noted. He believes his experiments have shown that a weight of 133 lbs. can be carried through the air with the expenditure of 1 HP., and that under certain conditions as much as 250 lbs. can be carried. MR. MAXIM has designed a special type of compound steam engine, using steam at 200 to 350 lbs. pressure. Two of these engines weigh 660 lbs. and develop over 100 HP., which MR. MAXIM thinks can be more than doubled. The steam generator weighs 350 lbs., and the whole motive apparatus, generator, engines, pumps and propellors, weigh 1,800 lbs. The rest of the machine weighs as much more. That MR. MAXIM has not as exaggerated ideas as some enthusiasts on aerial navigation is apparent from the following:

Of course I hope to succeed, and from the data obtained from the foregoing experiments, and from the information I have obtained from other sources, it seems almost certain that I shall do so; still I may not. It may, however, be remarked that for many years engineers and scientists have admitted that the navigation of the air is certain to come so soon as a motor could be discovered which had sufficient energy in proportion to its weight. This motor has been found, its power has been tested, and its weight is known. It would therefore appear that we are within measurable distance of a successful machine for navigating the air, and I believe it is certain to come within the next 10 years whether I succeed or not.

Many ask what use it will be put to in case it does succeed. To this I would reply, certainly not for carrying freight, and not, for a considerable time at least, for carrying passengers. When the first flying machine succeeds, its first great use will be for military purposes. It will at once become an engine of war, not only to reconnoiter the enemy's positions, as has been attempted with the so-called dirigible balloons, but also for carrying and dropping into the enemy's lines and country large bombs charged with high explosives. It does not require a prophet to foresee that successful machines of this character would at once make it possible for a nation possessing them to paralyze completely an enemy by destroying in a few hours the important bridges, armories, arsenals, gas and water-works, railway stations, public buildings, etc., and that all the modern means of defense, both by land and sea, which have cost untold millions would at once be rendered worthless.

Of course this mode of warfare would not do away completely with all forms of small fire-arms, which would still have to be used in order to enable these future engines of war to combat one another; but it is safe to assert that none but small and light guns would be used.

Flying machines of the future will of necessity be of a complicated and delicate nature, and will require the very highest order of scientific and mechanical skill to construct and operate them. France is to-day the only country in the world which has the plant and in which it would be possible to manufacture all the material and to construct a machine such as I am now experimenting with. Flying machines will therefore be employed only by the rich and highly civilized nations. Small nations and half-civilized tribes will have to content themselves with their present mode of warfare.

The series of California articles is continued this month with a description of life in Nicaragua in 1849, by one of a party of Yale graduates who started to California by this route at the time of the gold hunting fever of that year. Engineers who have recently visited the country may be interested to know how it looked 40 years ago. In the editorial departments "the Key to Municipal Reform" is stated to be to introduce a system which will secure the administration of municipal affairs by the best classes of men, who now prefer business life to the uncertainties of public service. This is almost identical with the conclusion reached by President ELIOT, in his paper in *The Forum*; but how to obtain this result is still the question of questions, and the editor of *The Century* throws no light on it except by advocating civil service examinations and promotions for merit. But as he very truly says, to educate public sentiment to this end will be a slow and arduous task.

—*Report of the Board of Public Works, Duluth, Minn.* for the year ending Feb. 28, 1891. Including a plan for a tunnel under the ship canal on Minnesota Point by WILLIAM SOOY SMITH, C. E., W. B. FULLER, City Engineer; G. T. HUGHES, Clerk. Pamph., pp. 62. Full page folding sheets of illustrations; also folding sheets of tables.

The work of the year is reviewed in this report and much information regarding the public works is presented by means of tables. City Engineer FULLER states that the experience of the year shows that on grades between 4 and 13%, the best available pavement is cedar blocks, not more than 6 ins in diameter, with spaces filled with a grout of Portland cement and sand. Results of cement tests are recorded at some length by C. E. LOCKE, Inspector of Cement. Diagrams illustrate this part of the report.

The report on tunneling beneath the ship canal is accompanied by several sheets of drawings. This is an alternative to the proposed bridge, a report on which, with drawings by A. P. BOLLER, C. E., was given in the last report of the Board.

—*Final Report to the Trustees of the Covington (Ky.) Reservoir.* By G. BOUSCAREN, Chief Engineer. Aug. 1, 1891. Pamph., pp. 172.

This is a report on the construction of works to supply Covington with water from the Ohio River, including a pumping station, three reservoirs or basins formed by an earth dam across a ravine and two subsidiary dams across prongs of the ravine, and the necessary force mains between the pumps and reservoirs, and between the latter and the city distribution. There are two 5,000,000-gall. compound, condensing vertical Gaskill pumping engines, with space provided for a 10,000,000-gall. pump. The reservoirs have a combined capacity, when filled to within 5 ft. of the curb, of 85,959,000 galls. The total cost of the plant to Aug. 1, 1891, was $1,119,012. The works were fully described and illustrated in ENGINEERING NEWS, May 10 and 17, 1890.

Besides a detailed description of the new supply the report contains specifications for various parts of the work and report of the engine tests by Mr. BOUSCAREN and CHARLES HARMONY.

—*Modern Ideas on Irrigation.* By H. SCOUGALL, C. E., Salt Lake City, 1891. Pamph., pp. 20. Price, 25 cts.

Mr. SCOUGALL urges that irrigation in this country be carried on in a more scientific way, and that American irrigators be guided more by foreign practice. He thinks that too much water is now being used in many localities, raising the ground water level and causing the appearance of alkali. In place of the cession to the several states and territories of the arid lands now owned by the Government, Mr. SCOUGALL advocates the construction by the general Government of irrigation works for the arid lands, after which the lands should be sold to settlers at the present nominal rates, plus the proportionate cost of the irrigating works and interest on the same. The payments might be made in installments.

On p. 7 Mr. SCOUGALL says: "It must not be forgotten that the main revenue of the United States is derived from the sale of its land." This is such a gross misstatement that it must be corrected. According to the "Statistical Abstract of the United States," p. 2, the total revenue from the sale of public lands from June 30, 1867, to June 30, 1890, was less than $100,000,000, while in no single year during the period named has the internal revenue been less than $102,000,000. The largest sum received from the sale of public lands in any single year was $11,202,017, for the year ending June 30, 1888, or but 3% of the total net ordinary receipts for the same year, which was $379,266,075.

The pamphlet is dedicated to the delegates to the recent Irrigation Congress at Salt Lake City and was evidently read before or distributed among the members of that body.

SOCIETY PROCEEDINGS.

American Street Railway Association.—The tenth annual meeting will be held at the Monongahela House, Pittsburg, Pa., Oct. 21, 22 and 23. Special committees will report on the following subjects: "A Perfect Electric Motor;" "A Year's Progress of Cable Motive Power;" "Public and State Treatment of Corporations;" "The Dependent—Overhead or Underground—System of Electric Motive Power," and "The Independent—Storage or Primary Battery—System of Electric Motive Power." A paper will be read on "Standards in Machinery and Appliances for Electric Railways."

The Association of Superintendents of Railway Bridges and Buildings has been organized at St. Louis, Mo. The officers are as follows:

President, O. J. Travis, Iowa Central Ry.; First Vice President, H. M. Hall, Ohio & Mississippi Ry.; Second Vice-President, J. B. Mitchell, Cleveland, Cincinnati, Chicago & St. Louis Ry.; Third Vice-President, James Stannard, Wabash R. R.; Fourth Vice President, G. W. Hinman, Louisville & Nashville R. R.; Treasurer, G. W. Reed, Lake Shore & Michigan Southern Ry.; Secretary C. W. Gooch, Des Moines & Northern Ry. Executive Committee, W. A. McGonagle, Duluth & Iron Range R. R.; W. R. Damon, Louisville, Evansville & St. Louis R. R.; G. W. Markaley, Cleveland, Cincinnati, Chicago & St. Louis Ry.; G. W. McGehee, Mobile & Ohio R. R.; J. E. Wallace, Wabash R. R., and G. W. Turner, St. Louis & San Francisco Ry.

Civil Engineers' Club of Cleveland, O.—A regular meeting was held Sept. 9, with President Gobeille in the chair, and 18 members present. It was voted to have visiting days, when the members of the club in a body will visit the different manufacturing establishments of Cleveland, and engineering works in the vicinity, and a permanent committee was appointed to designate the days, and arrange programmes. President Gobeille then read an interesting paper entitled "Straw and Corn on the Cob as Fuel for Domestic Purposes," in which it was stated that it had been found from experiments that the same quantity of heat could be generated by the combustion of straw or corn on the cob, pound for pound, as could be generated by the combustion of any other fuel. One of the principal difficulties in designing stoves for burning straw is to provide for the liquid products of combustion which are comparatively large in quantity. Several drawings of different stoves, designed for burning straw were exhibited, also diagrams showing temperature curves obtained by placing calorimeter and pyrometer readings from experiments recently made. The difficulties of burning lignite, and the need of stoves suitable for burning this material, which abounds in many parts of the country destitute of true coals, was also discussed. The results of ten experiments were plotted against the lines derived from similar treatment of bituminous coal.

Scandinavian Engineering Society.—At the regular monthly meeting held Sept. 17, at the Sherman House, Chicago, Mr. Karl L. Lehmann concluded his paper on "Wind bracing in Buildings." The paper contained a general discussion of the action of the wind on walls and roofs, with the following rule for wind pressure of sloping surfaces: Find the percentage of rise to spread, and the normal component of the wind is found for each 100th maximum pressure; for 30th take 2/10 of this, etc. The relation between height of the building and its crosswalls was given, as also the resistance of outside wall only. The influence of the inertia of the building was stated as being of little importance, as a 7-story, rather light building was found to have received the total strain from the wind in but 5 to 6 seconds. An approximate and handy rule for calculating knee bracing and overhead bracing was given, and also the correct method by means of deflections illustrated by an example to show the reliability of the approximate method. The influence of superimposed floor loads on the columns where knee bracing is applied was clearly shown and comparison made with common diagonal bracing. Roof trusses were considered with and without knee bracing, and the method of finding all the strains graphically given. Mr. Lehmann showed that the horizontal reaction of the wind pressure should not be equally divided on columns to the windward and leeward side, but that with the same sized columns about 5/8 goes to the leeward side and 3/8 to the windward side columns, but that with columns of different sections and lengths their flexibility must be considered. He recommended that the knee bracing should not be finally fixed before the total dead load was on the roof, as the arch action of the knee bracing is considerable. The resistance against wind from the flat based columns usually employed was mentioned, and the attention called to the lack of sufficient wind bracing in high buildings in Chicago.

THOS. G. PHILFELDT, Secretary.

Master Car and Locomotive Painters' Association.—The annual convention was held at Washington, D. C., Sept. 9, 10 and 11. At the opening session the roll call showed 62 members present. The election of officers resulted in the choice of the following: President, Jas. A. Gohen, Ches. & O., Huntington, W. Va.; First Vice-President, Wm. O. Quest, Pittsburg & Lake Erie, Pittsburg, Pa.; Second Vice-President, W. J. Carr., Buff., Roch. & Pitts., Rochester, N. Y.; Secretary and Treasurer, Robert McKeon, N. Y., P. & O., Kent, O.

In discussing methods of cleaning varnished surfaces the use of soap was universally condemned. One member had obtained excellent results by the use of kerosene with No. 0 pumice stone. If there was any tendency of the varnish to crawl on this surface a little turpentine wiped over it would remedy the trouble. Mr. Winters, of the Wabash, adds one pint of naptha to one pound of No. 00 pumice stone and one pound of golden mineral oil, and finds that this preparation renews the luster after over a year's service. Mr. Lowery advocated the use of oxalic acid.

The time necessary to properly paint a locomotive was discussed, and it was finally voted that when 10 days are allowed for painting an engine it should run for two years with one cleaning and revarnishing.

Several papers were read on finishing wooden headlinings, and corn starch and terra alba were the principal fillers recommended. The advocates of the latter material were rather more numerous.

There was also a discussion on the use of "rough stuff" on the exterior of passenger coaches. Secretary McKeon abandoned the use of rough stuff three years ago, and is satisfied the work wears as well without it. Other members, however, favored its use and a vote was passed that it ought not to be discarded.

Various topical queries were then taken up. The use of part or all shellac on hard wood interior finish was discussed, and the majority used shellac over wood filler and finished with varnish. Shellac is more durable than is generally supposed; but it needs occasional oiling.

Blacking for locomotive stacks is often made of boiled linseed oil and lamp black, made thin and put on when the stack is warm. Other mixtures are plumbago and rosin reduced with naptha and put on with a piece of waste: drop black thinned with turpentine and put on with a sponge; drop black, raw oil and varnish; lamp black and raw oil; and two members used asphaltum.

In freight car painting, Prince's metallic mixed with boiled oil was used by the majority, and it was the general opinion that three days are required to paint a car.

On the question of a stock room for paint stock and brushes, it was voted that no matter how small the shop, there should be a stock room.

For a floor paint for passenger cars, some use a coat of shellac over the standard paint and color of the road; and this wears better than varnish. Piece work was advocated as the best system of work for both employer and employee.

The next meeting will be held in Detroit, Mich., Sept. 8, 1892.

ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Published Weekly at Tribune Building, New York.

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CHAS. W. BAKER, E. E. R. TRATMAN, M. N. BAKER, F. P. BURT, } ASSOCIATE EDITORS
GEO. H. FROST.....BUSINESS MANAGER

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ENGINEERING NEWS PUBLISHING CO.

July 4, 1891.

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COMING TECHNICAL MEETINGS.

American Society of Swedish Engineers.—Oct. 3. At 250 Union St., Brooklyn, and 347 North 9th St., Philadelphia.
Northwest Railroad Club.—Oct. 8. Rooms, Union Station, St. Paul.
Civil Engineers' Society of St. Paul.—Oct. 3. Secy., C. L. Annan.
Engineers' Club of Kansas City.—Oct. 5. Rooms, Baird Building. Secy., H. Goldmark.
American Institute of Mining Engineers.—Glen Summit, Pa., Oct. 6. Secy., R. W. Raymond, 19 Burling Slip New York.
Western Society of Engineers.—Oct. 7. Secy., J. W. Weston, 250 La Salle St., Chicago.
American Society of Civil Engineers.—Oct. 7. Secy., Francis Collingwood, 127 East 23d St., New York.
Engineers' Club of St. Louis.—Oct. 7. Secy., Arthur Thatcher. Room 801, Odd Fellows' Building.
Boston Society of Civil Engineers.—Oct. 7. Secy., S. E. Tinkham, City Hall.
Engineering Association of the Southwest.—Oct. 9. Secy., O. H. Landrett, Nashville, Tenn.
Civil Engineers' Club of Cleveland.—Oct. 9. Secy., A. H. Porter, 50 Euclid Ave.
Northwestern Track and Bridge Association.—Oct. 9. Rooms, Union Station, St. Paul.
Atlanta Society of Civil Engineers.—Oct. 13. Secy., Parker N. Black, Room 39, Capitol Block.
Denver Society of Civil Engineers.—Oct. 13. "Municipal Engineering." Secy., Geo. H. Angell.
Northwestern Society of Engineers.—Oct. 13. Rooms, Occidental Block, Seattle. Secy., E. H. Warner.
Civil Engineers' Association of Kansas.—Oct. 14. Secy., J. C. Herring, Wichita, Kan.
New England Railroad Club.—Next meeting, Oct. 14, at United States Hotel, Boston. "Lighting of Passenger Cars." Secy., F. M. Curtis.
Engineers' Club of Cincinnati.—Oct. 15. Secy., J. F. Wilson.
New York Railroad Club.—Oct. 15. Rooms, Gilsey House.
Scandinavian Engineering Society of Chicago.—Oct. 15. Secy., T. G. Pihlfeldt, 118 Adams St.
Montana Society of Civil Engineers.—Oct. 17. Helena.
Western Railway Club.—Oct. 20. Rooms, Rookery Building, Chicago.
Engineers' Society of Western Pennsylvania.—Oct. 20. Secy., J. H. Harlow, Pittsburg, Pa.
American Street Railway Association.—Annual convention at Pittsburg, Pa., Oct. 21, 22, 23. Secy., Wm. J. Richardson, Brooklyn, N. Y.
Engineers' Club of Minneapolis.—Nov. 5. Rooms, Public Library Bldg. Secy., F. W. Cappelen.

AFTER a lengthy and able debate the Irrigation Congress, which has just concluded its labors at Salt Lake City, recommends the granting of all public lands, excepting mineral lands, to the States and Territories in trust, for the purpose of developing irrigation, and the enactment of better laws for the preservation of forests from fire. The subject is too broad for discussion here; but that some further and radical legislation is required in this connection no one can doubt. The suggestion of the congress seems to be a good one, for it is essential that the general government retain considerable control over these lands and the appropriation and use of water. At the present time streams flowing through one State have their waters so thoroughly utilized on land within that State that there is none left for use on the parts of the same stream that flow into another State. If the State owned the land absolutely this diversion could not be legally prevented. The handing over of large tracts of land to syndicates for development, now too common, should also be restricted rather than encouraged; and this end would be best accomplished by unprejudiced general government control. But if the public domains were ceded in trust, as here suggested, and their improvement by the State made subject to conditions which would compel fair practice, an irrigation commission, or some such court, appointed by the government could decide in all cases of conflicting interest. The financial conditions and the broad and antagonistic claims involved make the problem a knotty one; but it is a problem that the people of our vast Western territory must face and settle practically for themselves, and its final adjustment cannot be long delayed.

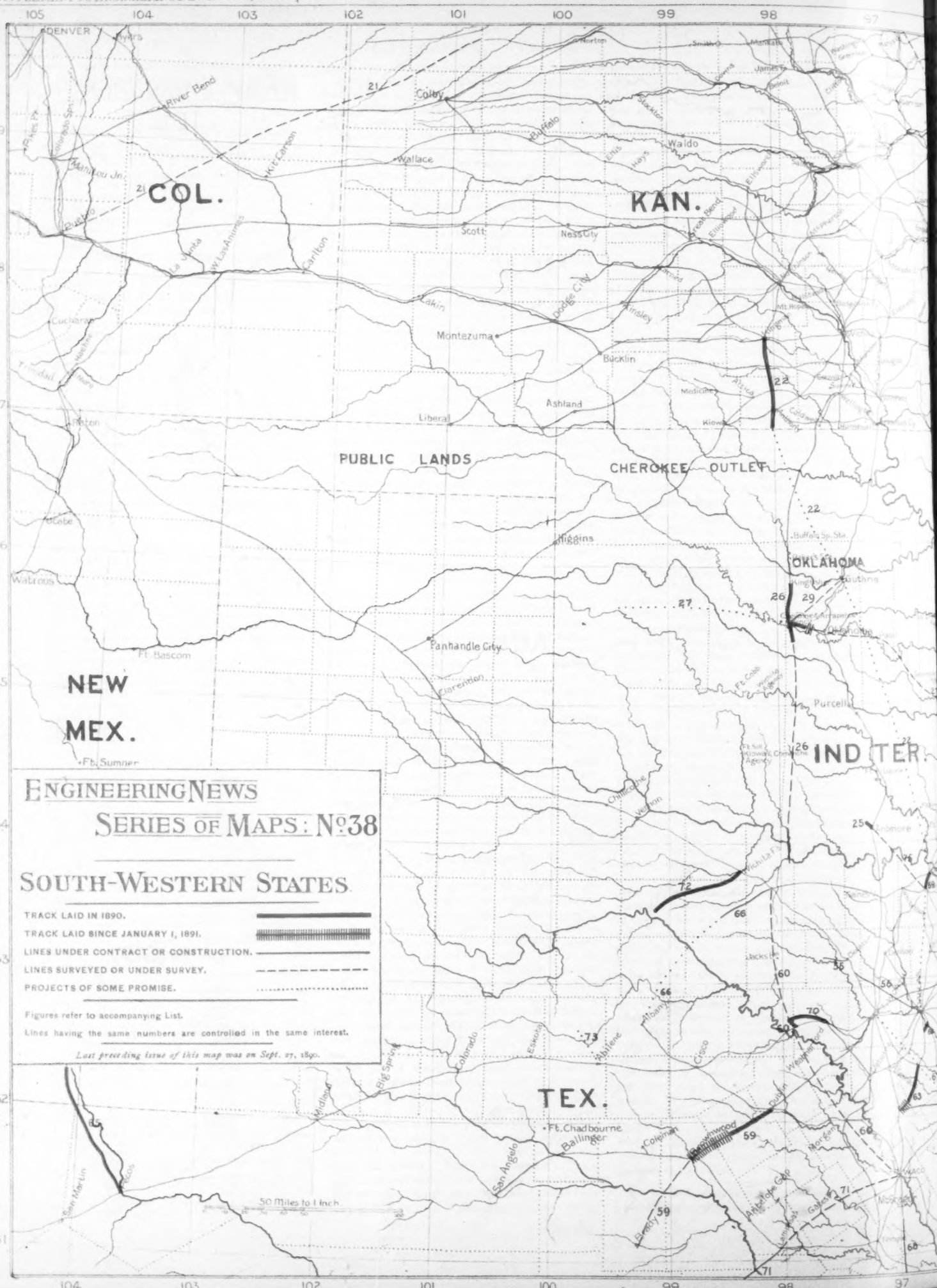
THE stand is taken by many in the Eastern section of our country that general tax levies cannot be applied to the development of individual States, especially when this development would directly interfere with the interests of the sections not benefited by these appropriations. While this view of the case will undoubtedly continue seriously to effect legislation in Congress, and the appropriation of public funds for the construction of reservoirs, etc., it is a narrow and unwise policy when pursued too far, the increased resources and wealth of any large section of our country means added wealth to the whole country, for in some way every community gains in the general distribution of this wealth, even though individuals do sometimes suffer. But as this feeling is acting as a brake upon irrigation progress in the far West, it is only wise to compromise, and the action suggested seems to fairly meet the demands of the case. Owing to the lack of pointed interest, and especially to the lack of funds, it is undoubtedly true that the present government control over the forests and irrigation areas of the West fails in many essential features, and especially in useful results. In a trip made several years ago from Tacoma to San Francisco, and from the latter city to Ogden, forest fires were everywhere visible, and no attempt was being made to check them. The resulting waste of valuable timber and the injurious reduction of water-storing areas was something that could not be measured in terms of dollars. Just what saving effect State appropriations and legislation would have had upon these fires we can not say; but it was evident that government control was having none. The states and territories in these sections are most vitally interested in the preservation of these forests and the development of land by irrigation; and it would seem altogether proper that they should, within certain limits, use the public domain as a capital stock, decide what it were best to do and do it themselves. While the country at large gains, as we have said, the greatest gain is theirs, and it is only right then that they should bear some part of the cost of execution of public works within their territory, and to control this work when done. But at the same time it is also right that as the general government pays for this improvement in lands, it should retain a close supervision over the distribution of water, and lay down some general rules of apportionment that would equally bind all the states or territories interested. Without such supervision, there would be continual conflict between states and diminished useful results. It is a subject of the greatest importance and the reception by Congress of the memorial to that body which is to issue from the Salt Lake meeting will be anxiously looked for. Irrigation is a vital factor in all substantial progress over a large portion of the United States, and some authorities maintain that the time may come when it will be of almost as much interest to those in the East as it now is in Colorado, California or Arizona.

THE collision on the Interurban Electric Railway between St. Paul and Minneapolis, which occured on Sept. 19, should teach a lesson to those who are advocating the use of high speed electric railways for long distance passenger traffic, and those who are planning their installation. If electric railways are operated at ordinary railway speeds and the precautions which experience has shown to be necessary for the safe movement of trains on ordinary railways are neglected, then sooner or later the penalty for this neglect must be paid.

The radical difference in the operating systems of street railways and ordinary railways is that cars or trains are sent out on street roads with no precautions to keep them at a safe distance apart. On a steam railway each train is given right of way to a certain portion of the track, and either by block system of signaling or by telegraphic orders from a train dispatcher, or by the use of cautionary signals to warn following trains, collisions are guarded against. To observe such precautions in the movement of horse cars would be ridiculous. The speed of a horse car is so low that its driver always has time to stop to avoid running into a car ahead. But as speed increases, the distance required to stop a car increases in greater ratio. Rear collisions of electric and cable cars, which run at a much higher speed than horse cars, are now quite common; but as their speed seldom exceeds about 15 miles per hour, the casualties from collisions are generally small.

When it is attempted to move cars at 25 to 30 miles per hour, however, it is no longer safe to rely on the motorneer's sight of the car ahead as the sole preventive of collisions. The distance in which it is possible to stop a car is increased to a point dangerously close to that at which the motorman can discern the speed of a car ahead. This latter is a difficult task, and, as a matter of fact, the motorneers generally content themselves with keeping a proper distance behind the car in front. It is when they allow this distance to lessen, under the impression that a car on the track ahead is moving, when in reality it is standing still, that collisions most frequently occur. Trains on elevated railways are probably run at greater speed with no reliance for spacing the trains other than the engineer's judgment than trains on any other roads; but it must be remembered that they can run safely on this system at much higher speed than electric surface trains because their stops are made at regular stations and the track is never obstructed to necessitate stops at other points; moreover, they are always fitted with power brakes. It is to be noted also that some of the railways operated on this plan, notably the Manhattan Elevated (New York), the Kings County Elevated (Brooklyn), and the Staten Island Rapid Transit roads, have adopted the block system for portions of their line.

THE advantages of electric rapid transit for such a line as that connecting St. Paul and Minneapolis



ENGINEERING NEWS
SERIES OF MAPS: No. 38

SOUTH-WESTERN STATES

TRACK LAID IN 1890.

TRACK LAID SINCE JANUARY 1, 1891.

LINES UNDER CONTRACT OR CONSTRUCTION.

LINES SURVEYED OR UNDER SURVEY.

PROJECTS OF SOME PROMISE.

Figures refer to accompanying List.

Lines having the same numbers are controlled in the same interest.

Last preceding issue of this map was on Sept. 27, 1890.

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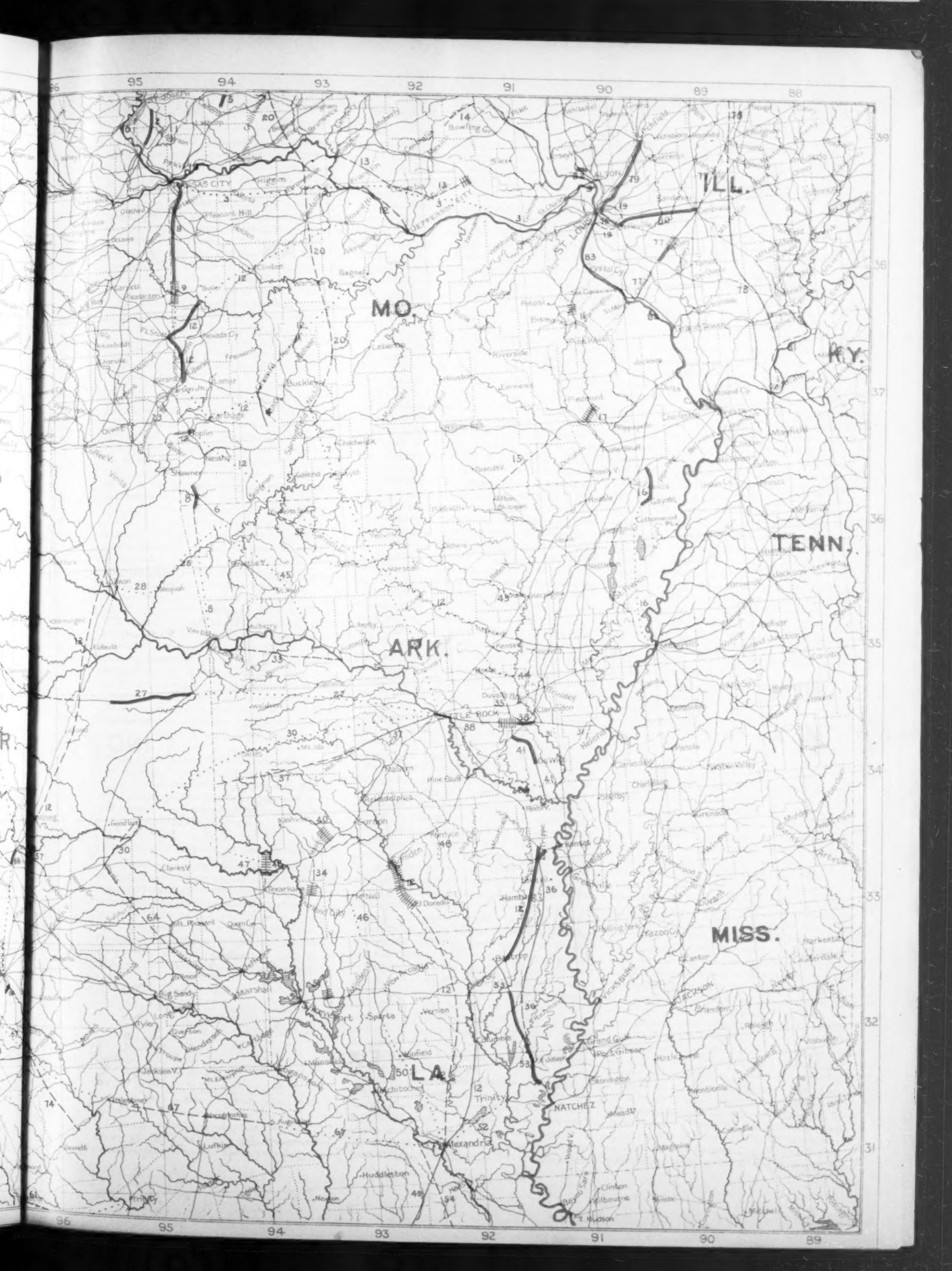
MO.
ILL.
KY.
TENN.
ARK.
MISS.
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ST LOUIS
JEFFERSON CITY
SAS CITY
LITTLE ROCK
NATCHEZ
Alexandria
Pleasant Hill
Buckley
Springfield
Joplin
Carthage
Marshall
Texarkana
Pine Bluff
Hamburg
Vicksburg
Jackson
Winfield
Sparta
Trinity
Huddleston
Lufkin
Clarendon
Duvall's Bl
Kansas City
Grand Gulf
Port Gibson
Natchez
Meadville
Monticello
Brandon
Canton
Yazoo City
Greenwood
Greenville
Clarksdale
Memphis
Jackson
Paducah
Cairo
Mayfield
Fulton
Union City
Dyersburg
Jackson
Trenton
Humboldt
Milan
Brownsville
Somerville
Bolivar
Corinth
Iuka
Tuscumbia
Florence
Huntsville
Decatur
Athens
Pulaski
Columbia
Nashville
Clarksville
Hopkinsville
Bowling Gr
Owensboro
Evansville
Vincennes
Terre Haute
Lafayette
Indianapolis
Peoria
Springfield
Quincy
Hannibal
Alton
Belleville
Centralia
Carbondale
Cairo

are numerous, and need not be recounted here; but it is a mistake to operate such a road at speeds of 25 to 30 miles per hour, without some system of preventing rear collisions more reliable than the unaided judgment of the motorneers. This is a point, however, which advocates of electric railway schemes are apt to lose sight of. They are accustomed in discussing the relative advantages of electricity and steam on railways, to lay much stress on the advantage of the electric motor in permitting the running of short trains or single cars at frequent intervals instead of large trains at long intervals. But it must be remembered that trains cannot safely be run on too short headway, and that in comparing the cost of electric and steam roads, the expensive signaling systems which the steam roads have found necessary will have to be provided also for the electric roads, in some form or other, if they are to be operated with safety and dispatch.

A CORRESPONDENT calls our attention to the fact that while the new Jersey City trainshed of the Pennsylvania Railroad has a roof of greater span than any other railway trainshed in existence, its dimensions are exceeded by the roof of the Machinery Hall erected for the Paris Exposition of 1889. This great building has a roof with a single span of 364 ft. 2 ins. between centers of end pins, and a total length of 1,390 ft. Each side is flanked by a gallery running the length of the building and increasing its total width to 492 ft. The Jersey City trainshed roof has a span of 252 ft. 8 ins. and a length of 650 ft. 6 ins. and was described in full in our last issue.

The roof trusses of the Machinery Hall are riveted steel arches, hinged at the foot and at the apex. The horizontal thrust is taken by the masonry pier instead of by a lower chord as in the Pennsylvania R. R. trainshed. Each pier is calculated to sustain a vertical load of 412 tons and a horizontal thrust of 115 tons. The outline of the roof trusses is quite different from that of the curved arches of the Pennsylvania R. R. trainshed, the truss being straight from the ridge to the eaves and the two halves coming together to form the ridge of the roof; the web system, too, is made up of alternate long and short panels, while the Jersey City arches are made up of panels of nearly equal length throughout.

These two structures with the somewhat smaller roof of the St. Pancras station in London, referred to last week, represent the greatest achievements thus far made in the covering of great open spaces, and are well worth study by those engaged in the design of works of this character.

Railway Construction in the Southwest.

From the map and statistics of railway construction which we present to our readers with this issue of ENGINEERING NEWS, it will be seen that, notwithstanding the adverse influences which have been at work during the year, there is a gratifyingly large amount of new work under way in the Southwest, especially in certain sections. The following table gives a summary by states of the mileage of new road in the various stages of progress:

	Track laid.		Under contract or construct'n.	Located and under survey.	Projects of some promise.
	1890.	To date in 1891.			
Mo.....	183.6	31.5	125	443	527
Kan.....	69.	2.	58	181	310
Ind. Ter..	105.9	6.	11	471	960
Ark.....	133	47.	174	331	982
La.....	128.4	65.	212	307	284
Tex.....	213.8	65.	438	905	1,146
Total.....	840.7	216.5	1,011	2,638	4,207

From these totals it appears that Texas still continues in the lead, both in the mileage in the actual process of construction and also in the mileage projected for future construction. Arkansas, Missouri and Louisiana follow Texas in the order named. In Kansas and Indian Territory there is very little actual work in progress, although the latter has a considerable mileage surveyed and projected upon which work is likely to be commenced in the near future. Each State in the list shows a large falling off from last year's figures, both in the mileage of railway under construction and track laid this year. The present totals of the mileage in the various stages of progress as compared with those published in connection with our last preceding map of this section are shown in the following table:

	Track laid. Year previous.	Track laid. Portion of year to date.	Under construction.	Under survey.	Projected.
Sept. 27, 1890.....	738	524	1,407	2,606	5,051
Oct. 3, 1891.....	841	217	1,011	2,638	4,207
Inc or dec., 1891.	+103	−307	−396	+32	−844
Inc. or dec., Per cent....	+13.9	−58.5	−28.1	+1.22	−16.6

It will be seen from an examination of our map and detailed list that with but one exception—the Missouri Pacific—none of the great systems have any work in progress. And this is not at all strange when considered in connection with the financial history of the railways in this section since the "boom" of construction in 1886 and 1887. With few exceptions, these roads have had to keep their wits about them to pay the operating expenses and fixed charges necessary to keep possession of extensions already constructed, letting any further construction severely alone. In view of this experience it would seem strange that capital should be found willing to engage in the construction of small local roads. It must be remembered, however, that this work is being carried on very conservatively and slowly, and that the new lines are located in the timber and coal regions, where a considerable local traffic is assured from the start; and, moreover, that they are generally of an inexpensive type and are, in many cases, coupled with land speculation schemes which, if judiciously managed, will, in a country of so great natural wealth, ultimately pay a good profit on the money invested.

In determining the question of future construction the largest and most important factor is, of course, the condition of the money market. For the past year, nearly, beginning with the financial stringency of last fall, there has been a general depression in all industrial enterprises, owing to the tightness of money. Business at present, however is showing signs of renewed life, and when the effect of the unusually large surpluses of food products shall have become fully felt by our transportation system there will be a still further revival. On the other hand, we have to consider the demand for money from the interior upon our eastern financial centers by these large crops, and the feeling of caution inspired among investors by the financial derangements of the past year. Of course it is impossible to say what may occur to disturb the growing confidence in eastern money markets, but aside from these possibilities the outlook would seem to be favorable for greatly increased activity in all industry. One of the most potent factors in this consideration will be the attitude of the coming Congress upon monetary affairs. The vast natural wealth which is only beginning to be developed will call for the construction of many miles of railway in this section. As yet, however, no very active movement in this direction is warranted by the industrial development of the country.

We have given elsewhere details of the work in progress in the various states, but a further mention of some of the more important enterprises may be of interest. In Missouri active work is almost entirely confined to a few short local lines. One of the most important enterprises is the Cleveland, St. Louis & Kansas City Ry., which has been before the public for some years under one name or another, and which completed 16¼ miles of track in 1887 and 1889, but since that time has done nothing. The line was projected to connect Kansas City and St. Louis, by a direct line across the State of Missouri, and the scheme included the construction of a bridge across the Mississippi River at Alton, Ill., and two Missouri River bridges. At present there seems no prospect of the work being resumed for some time. Another project of some importance is the possible extension of the recently completed St. Louis, Kennett & Southern R. R. to Memphis, Tenn. The only lines of the large systems having any work under way are the Missouri Pacific and the Kansas City, Ft. Scott & Memphis. Both of these companies have long lines projected south into Arkansas, penetrating the timber and mineral lands of northern Arkansas and southern Missouri. Of the newly projected lines the Springfield, Sedalia, Marshall & Northern, partly surveyed from Springfield to Chillicothe, 205 miles, is the most important.

Passing east into Illinois, we find several quite important enterprises under way in the portion of that state shown on our map. The longest of these lines are the Centralia & Chester, the Chicago & New Orleans, and the St. Louis, Chester & Grand Tower. The first named line has been under way for some years, and is sufficiently described in the accompanying list. Of the other two, the more important is the Chicago & New Orleans. This line is being built by an independent company, but it is intended to furnish the Chicago & Eastern Illinois Ry. an outlet to the south, and probably is largely under the control of that company. The St. Louis, Chester & Grand Tower R. R. Co., which is building the other line mentioned, has been organized, with the intention of ultimately absorbing the lines of the St. Louis, Cape Girardeau & Southwestern Ry., with which its projected line will connect at Cape Girardeau. The other work in this state is confined largeiy to short lines in the vicinity of St. Louis.

The new construction in Kansas can be described in a chapter nearly as brief as the famous one on "Snakes in Ireland." In no other state in this section is the falling off in construction so noticeable. In this state in 1886 there were 1,526 miles of track laid, in 1887, 2,102, and in 1888, 508 miles. Thus, for this year we have reports of only 2 miles of track laid, and 58 miles under contract or construction, and work is in actual progress upon only 7 miles of this. Of the many companies which were incorporated in Kansas a few years ago to build long railway lines, a few still hold their charters, but the most of them have vanished with the "booms" which called them into existence.

In Indian Territory there is very little construction in progress. The Chicago, Rock Island & Pacific and the Choctaw Coal & Railway Co., which last year had considerable work in progress, are now doing very little. The latter company is now in the hands of receivers, but its projectors hope soon to have its present difficulties adjusted and to proceed with the work. It is probable, however, that only the section between Ft. Reno and South McAlister will be built at present. The Chicago, Rock Island & Pacific now has its line surveyed to the Red River but does not seem disposed to do much building until the outlook is more favorable for a paying traffic upon its lines already built. The real fact of the matter is that the company is not in a condition to begin any very extensive new construction. Farther east the Missouri Pacific has surveyed an extension from Wagoner to Denison, Tex., about 180 miles, penetrating the bituminous coal fields in the southeastern portion of the territory. The Paris, Choctaw & Little Rock is another line projected through this same section. It is projected to run to Little Rock, Ark., but will probably connect with some one of the several lines projected

from Little Rock west, possibly with the Memphis, Little Rock & Pacific, which is shown on our map.

In Louisiana, Arkansas and Texas there have been very few changes from last year in the lines under way, and these are, except in a few cases, sufficiently shown in the detailed list. The large amount of construction which the Missouri Pacific has under way or projected in these three states is noticeable. Probably the most important of these lines is the Houston, Central Arkansas & Northern Ry., which will give the Gould system a direct connection with New Orleans from the north. In fact, if the present rumors are to be credited, its construction is but a part of Mr. GOULD'S proposed plan to divert all grain shipments over his lines to New Orleans and make this point one of the great grain exporting ports of this country. Another noticeable feature, and one which we have before commented on, is the importance which the little town of Alexandria is assuming as a railway center. It will be seen that nearly all of the various lines have a generally north and south direction, and serve to connect the east and west lines of the large systems. A considerable number of these are now independent, but, with the rapid consolidation and absorption of the smaller by the larger companies, which is now going on, it is doubtful if they remain so long, inasmuch as their location as connecting lines will make them especially susceptible to these processes.

Taking the Southwest as a whole, and considering its fertility, its great resources of minerals and timber, and its comparatively undeveloped condition and lack of proper railway facilities, the outlook for further railway construction is very favorable. Whether this construction will be done in the near future or not depends upon the conditions which we have already mentioned. Perhaps one of the most important works now on foot, in its commercial effects upon the states in this section, is the present movement for a deep-water harbor at the mouth of the Brazos River. The development of a large export traffic from this point cannot help but benefit this whole section, and at the same time, considering the time it will take for its development, it can have no appreciably ill effect upon the traffic of the present all-rail routes to New York and other eastern harbors.

PREHISTORIC IRRIGATION CANALS IN ARIZONA are really worthy of more notice than is usually given them. The Salt and Gila River valleys are intersected by a vast network of these canals which antidate, at least, the arrival of CORONADO in 1552, for he mentions these ruins and the traditions of the Indians regarding a once dense population in this region. Modern engineers cannot improve upon the lines of these canals, nor in the selection of points of diversion from the rivers. The first irrigation canal in this section, the one that has made Phœnix with its present population of 20,000, simply followed the lines of one of these old canals. Their extent may be appreciated when it is said that in the Salt River Valley alone the land covered by these canals once aggregated over 250,000 acres, and the canals themselves, with their laterals, must have exceeded 1,000 miles in length. This country is filled with prehistoric ruins, with walls of stone or adobe, and almost every acre contains fragments of pottery, sheel ornaments, stone implements and other remains of a population which can only be estimated in its aggregate.

THE ELECTRIC LIGHTING OF RAILWAY CARS, says the *Engineer*, has not yet reached a satisfactory practical, and commercial stage. The London, Brighton & South Coast Ry. Co. has had the system in use for some years, and with a certain amount of success as far as getting a light and running a light is concerned; but it is quite clear that, from a practical and economical point of view, it is inferior to gas lighting. The *Engineer* says that this company has decided to adopt the Pintsch oil-gas system of lighting, and that a large oil-gas works is to be built, and about 200 carriages are to be fitted at once.

CORRESPONDENCE.

Slope-Stake Setter.

MONTREAL, Sept. 24, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: I have read with interest the description of Mr. Cox's "Slope-stake Setter" in your issue of Sept. 12. Allow me to mention that in 1883 I took out a patent for an instrument on the same principle namely finding the position of the toe of the slope correctly without calculation, no matter how irregular the ground may be or whether covered with short brush or not. It works capitally in practice. The field operation is as follows: The engineer sets up over a center peg, notes the cut or fill as the case may be, slides the index arm to a corresponding height on the vertical scale, he holds one end of the tape, his rodman the other end, at a short target-rod about 4 ft. high. The exact point is found by trial, and when the reading on the index-arm, which, divides on the target, is the same as the tape reading the point is found. The other dimensions of the cross section at intermediate points can be measured at the same setting up. The instrument measures 5 ft. in height, with an index plate at top 6 by 9 in. and weighs about 3 lbs. It can be used in any weather.

Yours truly,

J. W. MASSY.

Tests of Iron Columns.

ITHACA, N. Y., Sept. 27, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: Your correspondent "B. F. LaR." asks for experiments on cast-iron columns, in your issue of Sept. 26. He can find the results of such experiments in the government report of tests made at the Watertown Arsenal, for 1887 and 1888. Also in Bauschinger's "Mittheilungen ans der Mechanisch-Technischen Laboratorium der K. Hochschule im München," Hefte XII. u. XV.

A very good abstract of all these articles, with discussion and criticism, will be found in Lanza's "Applied Mechanics," fourth edition, 1890. Published by Wiley & Sons.

Very respectfully,

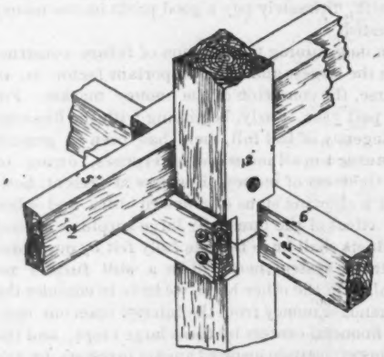
CHAS. W. SHERMAN.

Joint for Trestle Post.

CEDAR BLUFF, Va., Sept. 26, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

Referring to your issue of Sept. 19, 1891, on page 266 of which you illustrate a trestle joint used by Mr. J. P. SUVERKROP, Chief Engineer of the Harriman Coal & Iron Co., I beg to inclose herewith an isometric view of a joint for double deck (and over) trestles, which has been used



on the Shenandoah Valley and Norfolk & Western railways by Chief Engineer W. W. COE for the past ten years or more. You will observe that Mr. SUVERKROP'S joint shows a marked resemblance to the same.

EMILE LOW,
Engineer in Charge, C. V. Division,
Norfolk & Western R. R.

Errata in "The Cleaning and Sewerage of Cities."

TO THE EDITOR OF ENGINEERING NEWS.

SIR.—I beg to call your attention to a very glaring error of translation on page 103 of your publication of Baumeister's Sewerage. Your translator says "Several English cities—Oxford, Windsor, Reading and others—*were so sewered by Waring*." In the German (original) copy which my teacher, Prof. Baumeister, kindly sent me, he says: "*Long before Waring* several English cities—Oxford, Windsor, Reading, etc.—were sewered upon a modification of the separate sewer system."

He continues by saying that quite recently the city of Goettingen (University) has been so sewered; while in your translation you say "Gottinger has recently constructed a system on this plan." WM. PAUL GERHARD.

The Proposed Subways for Toronto.

TORONTO, Sept. 28, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: In your issue of Sept. 26 I observe a description of proposed subways for one of our city streets, taken from my report for 1890, and on page 203 you mention that an estimate of the cost is not appended. Kindly allow me to correct this statement, as on page 48 of my report for 1890, Appendix "C," you will find an estimate of the cost per lineal foot of tunnels, which is applicable to both cases. I may say that while preferring two subways (one adjoining each curb of roadway), I added the drawing showing the single subway in the center of roadway, as a number of property owners were under the impression that this would be the most economical, and it was merely for the purposes of demonstration that it was given.

Yours truly, WM. T. JENNINGS, *City Engineer*.

[The estimated cost referred to, and overlooked by us, is $18 per lin. ft. either for tunnels on both sides or one tunnel in center of street.—ED. ENG. NEWS.]

Steel Foundations.

CHICAGO, Sept. 23, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR:—In your issue of Sept. 19 we notice a criticism or a supposed criticism by Mr. LA RUE upon the method of computing moments and of the equated "moments of resistance" in Steel Foundations as explained by Mr. PURDY'S article published Aug. 8 in your paper. We also note the editor's synopsis of Mr. PURDY'S reply to the criticism or defense of the calculations. As Mr. PURDY'S example and accompanying drawings were taken from the foundations of "The Fair" and as we are probably the designers referred to in the synopsis of his reply as "not having deemed it necessary to provide for the moment," we think it but just to ourselves and certainly it is demanded for the reputation of "The Fair" as a well designed structure that the criticism by Mr. LA RUE be more definitely answered than in the synopsis above mentioned.

If Mr. LA RUE were to follow his own reasoning in figuring the strength of any built beam or truss, he would have to conclude that its total moment of resistance was equal to the moment of resistance of the top chord plus the moment of resistance of the bottom chord, plus the moment of resistance of the web, if it have one, the moment of each piece being figured about an axis through its own center of gravity, which is a conclusion far from correct. If, on the contrary, he will figure the foundation as a built beam, which it is, and in the case he mentions take the second and fourth courses as top and bottom chords, while the third course forms the web, he will find the built beam has excess of strength at the line which, by his reasoning, is falsely proved to be weak by 41%. That this method of considering the foundation to be a built beam is correct, would be very evident to any one who has seen the work in process of construction or who has carefully studied the drawings. The Portland cement concrete holds the beams in the different layers in such a way that any motion is as impossible as it would be between top and bottom chords of a truss.

MR. LA RUE'S failure to compute the foundation in the manner last described "is simply an oversight; but that it is one of no small importance will, we think, be freely admitted." We "much regret" his error and especially so as his criticism might lead some readers who saw only his communication to believe that the foundations already constructed are weak. "Having noticed his oversight it becomes our simple duty to call attention to it."

WILLARD M. CLAPP,
Engineer for W. L. B. Jenney & W. B. Mundie, Architects of "The Fair."

Kirkaldy's Work on Testing.

NEW YORK, Sept. 23, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: In your issue of Sept. 19 under the heading "Concerning the Kirkaldy System of Testing Materials," you give a general review of the book mentioned and state that the views and opinions given are those of an authority on this subject. Permit me to take exception to some of the views stated.

Having read KIRKALDY'S book carefully, I think I am familiar with the contents, and wish to say at once that although it claims on the title page to describe the system of testing carried out at the Kirkaldy Testing Works, nowhere in the entire book is anything whatever mentioned which can be construed as a description of the system of testing in use, though the shapes of test pieces are mentioned.

The valuable conclusions given by KIRKALDY were not deduced from the tests given in the book, but every one of them had been stated long before any of these tests had been made.

Furthermore, although KIRKALDY'S motto is "facts, not opinions," it is precisely in those cases where the facts would be most important the author gives his opin-

ion and dictum, and fails to give the facts in the book in question. He does not state how the tests were made, what auxiliary apparatus was used, and other matters of importance.

In the review it is stated that KIRKALDY has done much to establish and maintain uniform standards, etc.; but this fact is only partially true, and as the methods of testing are not described in the book, the statement is unwarranted, especially as only a few investigators have adopted his shapes for test pieces.

The reviewer distinctly makes a mistake when he regrets that the 10-in. standard has not been adopted in this country, merely to follow KIRKALDY; he seems to forget that in France, England and Germany almost all the work has been done on 8-in. standard lengths (or 200 mm.), and that comparisons can only be made between similar test pieces. The very slight advantage of decimal lengths is of little importance in such work when all dimensions are given in decimals for all cases; it is of no importance that the first whole figure is an inch or a meter. It is not true that a test made on a piece 8 in. long loses its value in comparison with a 200-mm. standard length, as the two lengths vary but 3 mm. or 1½%; a difference in length of 2 in. or 25%, however, makes the tests non-comparable. In view of the fact that most and the best testing always was done on 200-mm. and 8-in. test pieces, KIRKALDY is wrong in trying to force his adopted standard of length on the world and Mr. HUNT knows that one accustomed to measuring elongation of an 8-in. length can state the per cent. of elongation almost by instinct or habit and requires almost no calculation. It must be remembered that percentages of elongation are generally given in three figures (one decimal only) as the fourth figure is beyond limit of accuracy of observations of load and extension. Moreover the adoption of an 8-in. standard will require no material change should the metric system be adopted in this country.

Mr. HUNT furthermore upholds KIRKALDY in his antiquated idea of referring tenacity to fractured section, when he says: "It is certainly an advantage to have the terms of the ultimate strength put in relation to the ductility of the specimen, as giving the ultimate strength in terms of the fractured area would do." It is not true that the fractured area is a measure of ductility, except in rare cases; but it is dependent almost entirely upon local or accidental conditions in the test piece; and if Mr. HUNT had followed the literature on this subject during the last ten years, he would hardly have made such a statement; or, had he but studied his own extensive series of tests, he would necessarily have reached the same conclusion. KIRKALDY is now almost the only investigator who still holds that opinion, and inquiry will prove that he does so merely because he adopted this method nearly 30 years ago and is now too old a man to change.

Mr. HUNT also says that he does not agree with KIRKALDY in his utter condemnation of all methods of determining the elastic limit not depending upon the measurement of elongation, and simply because he himself never determines this point, but invariably determines the approximate "yield point" of materials alone, which lies above the elastic limit. KIRKALDY is correct in his position in this matter, and his observations are free from so many possible accidental errors which are always possible in observations of drop of beam, etc., etc.

The elastic limit is the only safe limit to use as a basis for calculation of structural dimensions, and it is to be regretted that it has not been generally adopted. All our theories of behavior or resistance of structures are based upon elastic, not ultimate, properties of materials, and it is inconsistent to use other data than elastic limit and elastic extensions to calculate the behavior of structures of all kinds; in fact the failure do so has often been the cause of failure (not rupture) of structures. Whoever thinks of using ultimate extensions of material to determine distortion or deflection of structures? Still, very few hesitate to thus use tenacity instead of elastic limit for such purposes. If it were better known that the elastic curve and limit, accurately determined, are almost absolute guides or indications of effects of rolling as well as of "overheating," the statement: "It is not a safe factor to use alone, at least for determining the character of iron and steel" would not appear. It is true that the necessary observations take time, patience, care and knowledge; but the remedy is not to neglect these, but to devise rapid and accurate means of determining the necessary data.

Again, Mr. KIRKALDY is correct when he asserts that higher steel would give better results with the better methods of working materials obtaining abroad; and Mr. HUNT overlooks the fact that the poor methods used in many of our American works prohibit the use of a better material and compel the use of a weaker one, while the remedy would consist in adopting better shop methods, which are known to be cheaper ultimately than the poorer ones now in use. The higher metal suggested by KIRKALDY is not so high that it would give trouble in rolling or fabrication.

Inasmuch as elongation and reduction of area are not interdependent, KIRKALDY is certainly correct in insisting that the more important only should be required. Mr. HUNT fails to admit what is well known abroad, and in a number of works and shops here, that ductility is not measured by reduction of area, but rather by elongation, and then only up to the point of maximum load; and he does not know that in boiler plate especially, the best material by actual experience during many years is not that which shows the greatest per cent. of reduction of area, but that which shows the greatest uniformity in cubic reduction up to the maximum load carried by the specimen, irrespective of reduction of area.

Mr. HUNT expresses surprise at KIRKALDY's thirty-fourth conclusion, and says that "it is a circumstance that has heretofore been overlooked." This is a truly amazing statement, as volumes have been written on the subject, and whole essays and series of investigations published in at least three languages treat of nothing else. This fact was among the first discovered when testing became general, and it would reflect greatly upon the knowledge of American engineers were such statements allowed to pass unnoticed.

The statement that the book "brings out data which will be of considerable interest to electrical engineers" is decidedly exaggerated, and not in accordance with fact, and had Mr. HUNT seen the facts on this subject, as given in the reports of the Royal Prussian Testing Laboratory at Berlin, and of several engineers of the Eastern Ry. and the Paris, Lyons & Mediterranean Ry. of France, he would have valued these insignificant references but slightly, particularly as no description is given of surrounding conditions and materials.

Although KIRKALDY's book is handsomely printed and admirably arranged, containing considerable valuable information to the initiated, the statement that "it is a work of extreme scientific value, and one that every engineer should read and have as a book of reference," is one of such exaggerated laudation that it is unwarranted and incomprehensible. KIRKALDY fails to do more than half of what is promised in the preface of the work, and gives merely an immense array of averages and figures, according to his ideas. He fails to give what in scientific work of the present day is considered the first importance viz.: a clear and full statement of methods and means, and also proof of correctness of all observations and measurements as well as of the apparatus used. As KIRKALDY has persistently and continuously refused to do anything of the kind, and in fact has taken the greatest pains to conceal such knowledge from the world, and does not touch upon these matters in his book, the latter loses its scientific value, and the results or facts given cannot be entirely interpreted by even those who are well read in the art of testing.

Nothing is more to be regretted, after having read KIRKALDY's book carefully, that with his immense array of facts and figures he has failed to advance our knowledge of the interdependence of shape and results, and has given a heap of undigested food without the means or tonic necessary for assimilation, for which he was so preeminently fitted. Have his 25 years of uninterrupted investigations, for which he has been handsomely paid, not fitted him to draw general conclusions? Or what are the essential results or conclusions to be drawn from a perusal of his book? Nobody can tell. Remember his 66 conclusions were all drawn more than 25 years ago, and based on results obtained before his present machines and apparatus had been designed, much less executed. When appearing before the world with such a pretentious book, does it not seem to be KIRKALDY's duty to give us all the facts, if he is looking for justification? What a grand opportunity this was to rear a great and lasting monument! What a pity it has turned out so differently!

When I visited Mr. KIRKALDY in his laboratory, two years ago, he told me of the writing of the book and showed me some of the tables and curves then completed, and I was looking forward to one of the best works on the resistance of materials ever published. Very few can realize the dismay and disappointment caused by a study of the book several months ago; and it is to be hoped that in a later work by a more judicious author KIRKALDY's reputation will be redeemed. Yours truly,

GUS C. HENNING.

[While authorities on the testing of materials will differ, we must in justice to Mr. HUNT call attention to several of the points made by our correspondent. The reviewer is made to uphold KIRKALDY "in his antiquated idea of referring tenacity to fractured sections;" but we notice that Mr. HUNT prefaces his remarks on this subject by saying: "This system is not carried out at all in American practice, and the writer does not consider it an advantage to do so, due to the difficulty of measuring the fractured area." Our correspondent also certainly misunderstands the reviewer when he says that "Mr. HUNT says also that he does not agree with KIRKALDY in his utter condemnation of all methods of determining the elastic limit not depending on the measurement of elongation, and simply because he himself never determines this point, but simply determines the approximate yielding point of the material, which lies above the elastic limit." It is a very general practice with the engineers of tests for Carnegie, Phipps & Co., Phœnix Iron Works, Pencoyd Iron Works, Oliver Iron and Steel Works, Jones & Laughlin and other prominent manufacturers, to use the simpler methods in speedily determining whether the elastic limit in the material will answer the requirement of specifications. But for closer work the Olsen testing machine with its diagrams is commonly employed, and such a machine is in very general use by Mr. HUNT himself, and it very accurately determines the point where the increments of extension are not proportionate to the increments of load. As the reviewer says, time in these tests is also commercially valuable in many cases. In regard to the comment in the review on KIRKALDY's thirty-fourth conclusion, we admit that the reviewer has made a more sweeping assertion than he probably meant. As Mr. HUNT was referring to American and not foreign mill practice, it would have been better had he said "has been generally overlooked in America." In this statement he would have been nearer correct, for, as far as our experience goes, it is decidedly the exception to the general rule, in the reports of tests of steel, to mention the lateral dimensions of the specimens.—ED. ENG. NEWS.]

The Lake in the Colorado Desert.

In southeastern California, in the counties of San Diego, San Bernardino and Inyo, there is a barren arid tract of land, about 35,000 sq. miles in extent, which is equally remarkable for its topographical features and for its climate. There are two large tracts in this region which are considerably below sea level. The more noted one is "Death Valley," in Inyo County, lying 175 miles northeast of Los Angeles and not far from the Nevada line. The area below the level of the sea is about 36 miles long and 10 miles wide. The lowest point is about 150 ft. below sea level. Into this depression, or "sink," the Amargosa river flows. In winter the basin is a dreary mud flat, in summer it is a parched desert.

The other tract below sea level is the Coahuila Valley, located 200 miles south of Death Valley and 75 miles northwest of Yuma, Ariz. The main line of the Southern Pacific Ry. runs through this valley, and for a distance of 61 miles the line is below sea level, reaching at one point a depression of 263 ft. The lowest point of the basin is said to be about 300 ft. below sea level. The width of the area below sea level is not accurately known, surveys of the region being matters of great difficulty and danger; but it is generally taken as 20 to 25 miles wide. A traveler through the region says:

> From San Gorgonio to El Rio the railway runs through the most remorseless, cruel waste of sand and rock I ever beheld. It spreads out up to the foot of the rugged hills of the San Bernardino range, an abomination of desolation, compared with which the Libyan desert is the Garden of Hesperides. I cannot describe, nor could I at any time hope to give an adequate conception of this dreadful wilderness. For 167 miles there is not a drop of water to be found.

Just south of the railway is a level tract, the dry bed of a lake, in the center of which is a pool of boiling mud about a half mile in length, and 500 yds. in width.

The rainfall in this region, and all through the Colorado and Mohave deserts is said by General GREELY, in his book on "American Weather," to be less than in any other district in the world. The annual average rainfall at Indio (see map) is but 1.92 ins. At Yuma it is only 2.81 ins.

The cause of the formation of this depression is thus explained by Major POWELL, of the U. S. Geological Survey. The Colorado River, rising in the high plateaus of the Rocky Mountains, and falling at a rapid rate throughout its whole course, has eroded a deep channel through the soft tertiary rocks, over which its course lies. The silt and débris brought down by the river have been deposited in the delta at its mouth; and in this way a dam was gradually formed, cutting off a portion of the Gulf of California from the ocean. Under the hot sun and dry climate of the region, evaporation was rapid; and the portion of the sea thus cut off soon became a dry basin, whose sands were drifted by the winds, and whose surface was more or less broken by volcanic upheavals.

The Colorado River is also peculiar for its great rise and fall. The narrow canyon through which it

runs gives it little chance to equalize its flow by spreading out over meadows and bottom lands; and, like the flushing of a sewer, the floods on the headwaters flow down to its mouth little abated in their height. But the burden of silt which the river brings down from the mountains is continually raising its bed; and eventually it becomes higher than the land on either side. Then at some great flood it bursts its banks and goes off in new channels.

The story of the formation of the new lake in the Colorado desert is briefly as follows: During the floods of last summer the Colorado river rose to such a point that it broke through its banks at a place about 8 miles below El Rio, a station on the Southern Pacific a few miles west of Yuma, and flowed to the west in several channels from four to six feet in depth and thirty to forty feet in width. These streams followed the general route of the old stage road and near Alamo Mocho they united in one stream over 100 yds. wide and flowing at about 4 miles per hour. The old slough or channel at this point had a depth of about 20 ft. From this point the stream flowed onward toward the sink in the

MAP OF PORTION OF COLORADO DESERT IN SAN DIEGO CO., CAL.

desert, spreading out over the country in a broad sheet sometimes two miles in width. There was also a flow of less amount from the Colorado River into the desert through New River.

The total volume of these two streams last June was about 16,000 cu. ft. per second. With the fall of the Colorado River this was reduced by the middle of August to about 3,000 cu. ft. per second. At this time the lake covered an area of about 150 sq. miles and the evaporation was sufficient to balance the flow. Probably the whole lake will have dried away before next year's floods; but it will then be filled again, to a depth greater or less, according to the height of the main river and the amount of silting up or erosion of the overflow channel.

As already stated no accurate surveys of the Coahuila Valley have been made, so far as we can ascertain. The most accurate map of the region which we have been able to find is one engraved by Julius Bien & Co. for the California State Geological Survey, published in 1874. By permission of the publisher we have reproduced the portion covering San Diego County, which includes the Coahuila Valley, making such corrections as were possible from later existing maps. One error in the topography, which was discovered too late for correction, is the extension of the foothills across the portion of the railway line below sea level. Actually the railway is located down in the valley; as above noted, and would have to be moved back to the foothills should the whole current of the Colorado ever be turned into this basin. We have shown in dotted lines on the map the approximate channel of the stream from the crevasse, which occurred last June and is described above.

The area of the tract below sea level in the Coahuila Valley, which would be filled if sufficient water were diverted to it from the Colorado, is variously stated at 1,600 to 3,000 sq. miles. The smaller figure is probably nearer the truth, the authority on which it is given being a survey made by one Lieut. BERGLAND about 30 years ago to determine the feasibility of an irrigation scheme proposed by the late OLIVER M. WOZENCRAFT of San Bernardino, by which it was proposed to take water from the Colorado to irrigate all that portion of the desert which lies at a lower level than the river. Dr. WOZENCRAFT estimated that 500,000 acres could be brought under cultivation by this scheme. It was proposed to take water from the Colorado at a point about 120 ft. above sea level. We quote the following from the report of the surveys then made:

After having made a careful reconnoisance of the country, I was forcibly impressed with the practicability of taking water from the Colorado River over a great portion of it, inasmuch as there is the unmistakable evidence of water having flowed from the river in through innumerable channels and finally concentrating into one of some magnitude, by which the water is conducted far up into the basin; water having passed through this channel (from the Colorado River) soon after our acquisition of the country, it was called New River and Old River.

The practicability being thus settled by the laws of nature, I sought to determine on a suitable point to tap the river, and was fortunate in finding a location which possessed so many advantages that I was at no loss in making the selection. It is that point of rock adjacent to Pilot Knob. The recent alluvial formations of the banks of the Colorado will not admit of tapping the river without risk of changing its channel and destruction of the works necessary in regulating the volume of water to be taken out. Hence the necessity of taking advantage of a point of durable formation, and so situated as to insure a juncture with the river at all times. This point being determined on, I proceeded to run a line of levels, the result of which showed a mean fall of four feet to the mile through the entire extent of country proposed to be irrigated. * * * * * * * *

The area of land which may be irrigated may be set down at 20 miles in width and 40 in length. This estimate must be taken with all due allowance and in connection with the obstacles in making the estimate. A portion of the lands within the boundary which may be irrigated are irreclaimable, owing to their formation and composition, such as sand drifts, elevations, mud volcanoes, alkalies and salt beds. Also it would be difficult, if not impossible, to make an estimate of the volume of water which may be spared or safely taken from the Colorado River, or the area of lands which a given volume of water will irrigate.

Another scheme which has found some advocates, has been to permanently turn the Colorado's course, so that the whole area below sea level in the Coahuila Valley would be submerged. It was argued that the great evaporation from this body of water would have a marked effect in modifying the aridity of the climate of all the adjacent region. In this month's *Scribner's*, Major J. W. POWELL, Director of the United States Geological Survey, discusses this question in connection with the new desert lake. He shows by the general laws which govern rainfall, that it is the cooling of a warm air current which produces rain rather than proximity to bodies of water and that some of the most arid regions on earth are located on the edge of great bodies of water. Where a current of air from the ocean is warmed as it passes over the land, its capacity for moisture is increased. Where the contrary is true and the ocean breeze is cooled as it passes over the land, it gives up its moisture in the form of rain.

The theory that the creation of bodies of water will ameliorate the desert conditions is the one now in hand. On this theory it has been proposed to revolutionize the desert of Sahara by taking water from the sea by a canal into a low basin of the desert, and, though physical geographers have again and again affirmed that this would not affect the climate in any appreciable manner, yet the scheme comes to the surface of popular agitation from time to time. So it has been proposed to change the Colorado desert by filling the Coahuila basin with water. But land is not assured against aridity by the presence of bodies of water. The peninsula of California is almost surrounded by a body of water, and to the west is the great Pacific Ocean, and yets its aridity is excelled in but few places on the globe. On the Polynesian Islands there are atolls—that is, little bodies of land surrounded by vast ocean spaces—that are almost as arid as the desert of Colorado.

The future of the basin, if regulated by nature alone, will be as its past. From time to time a strand of the river will enter it and its bottom will be covered by a brackish lake; from time to time the whole current will pay tribute, it will be filled to the brim, and "Hardy's Colorado" will become "the Colorado;" from time to time the swaying river will avoid it altogether, the sun will drink its water, and a new film of salt will be added to its desert plain.

But the problem no longer belongs to nature alone, for civilized man is upon the scene. In the near or distant future he will control the river, and by its aid regulate the condition of the valley. To-day he talks of obstructing the western sloughs by dams, so that the Colorado shall be permanently contained within its present channel, and the settlements and railways of the basin shall not be compelled to choose new sites above the threatening tide. If this course is adopted and continued, the task of restraining the river will at first be comparatively easy, but the time will come when the tract of delta it now traverses will be built so high that massive and costly walls will be needed to restrain the struggling stream.

Major POWELL further shows that even if the proposed lake were formed, and all the water evaporated from its surface were precipitated on the arid plains of Southern California and Arizona it would at best increase their annual rainfall but a fraction of an inch.

The scheme of irrigating the basin, however, by diverting a regulated portion of the flow of the river seems to him a feasible one. The difficulty of constructing canals in the shifting soil of the desert and of regulating the flow from the river at all stages are very great. Another difficulty is found in the character of the water, which carries in solution a considerable amount of salt and sulphate of lime. Nevertheless these obstacles might be successfully overcome; and the rewards would then be great, for in that climate every farm is a garden. Treated in this way the ancient delta of the Colorado, for so many years a desert, might become the Egypt of America.

Railways in Burmah; the Abt Rack-Rail System.

According to *Indian Engineering*, an attempt is being made to organize a company to build a meter gage railway through the Shan States from Mandalay to Kunlon, on the Salween River, a distance of 285 miles. It would form a continuation of the Toungnoo & Mandalay line. The reports of Mr. F. R. BAGLEY, the engineer who made the survey, show that a large proportion of the distance would be comparatively easy construction, with maximum grades of 1 in 40 to 1 in 80 (2.5 to 1.25%). There will be some tunnels and bridges of 150 to 250 ft. span. There are two summits or "saddles" to be crossed, on which the use of the Abt rack-rail system is recommended as follows:

A grade of 1 in 40 (2.5%) is believed practicable to a saddle 3,220 ft. high, about 3 miles northeast of Memauk The formation of the hills in the neighborhood is, however, specially suitable for a steep grade line of 1 in 16 (6.25%) on the improved Abt rack-rail system; and if this system be adopted, a line can be laid down which will serve a distance of 15 miles. The steeper grade would enable the line to follow the hillsides more closely, avoiding tunnels, viaducts and much heavy work.

The additional cost of the rack-rail system on permanent way, including the grip or pinion attachment to the locomotive, does not cost more than $12,500 per mile, and it may be added that both the present and late consulting engineers to the Government of India are highly in favor of the system for India and the Shan Railway in particular. The rack-rail insures perfect safety, as there is no possibility of "slip," which, on ordinary permanent way, causes much delay and waste of power when the rails are greasy, as they would certainly be in the damp and foggy weather in the Shan hills.

The adoption of the rack-rail at the "Goteek Gorge" will effect a large saving by reducing the ascent to the gorge and the length of the tunnel.

New Saloon Car for the Furness Railway, England.

From the *Railway Press*, of London, we abstract the following description of a saloon car for the Furness Railway, built at the company's works at Barrow:

A new saloon car, which has been designed by Mr. T. SUTTON, the company's car superintendent, and built under his supervision at the car works at Barrow, is worthy of notice, because not only is it quite unique in its arrangements, but it is one of the most sumptuously and elaborately fitted up saloons to be found on any railway in the country. The car is 34 ft. 6 ins. long, and is practically divided into four compartments, exclusive of lavatory and closet accommodation. One end is set apart for a baggage compartment and accommodation for the conductor, and is fitted with the ordinary handbrake and vacuum brake. The car can be placed in the middle of a train, or placed at the rear end, and made into a "slip" car—that is, it can be slipped off at any station without stopping the train or slackening speed. The compartment is lighted by about eight windows. The wood is grained a light oak, and the floor laid with linoleum, the windows being fitted with blinds. A sliding door in the partition opens into a cosy compartment seated for four persons—that is a seat on each side of the doors, the other door leading into the main saloon. The seats are of polished walnut, upholstered in fine dark blue cloth, the doors are also covered with the same material with gold moldings. The sides, ends and roof are very neatly decorated with Lincrusta panel work in cream and and gold. Over each seat and window are beautiful photographic views of scenes in the Lake District. The panels in the saloon and *coupé* contain figures and wild and domestic animals in dull gold. Access may be obtained from one end of the car to the other by means of sliding doors, which may be closed when the privacy of any compartment is desired, although each compartment has independent access from the outside. Beyond the baggage compartment are an elaborately fitted up lavatory on the right of the passage, and a closet on the left. Light to these is obtained by figured frosted glass windows, in which are the arms and monogram of the company. At night they can be lighted with lamps. These two apartments are supplied with water from a large cistern placed near the roof. The next sliding door opens into a small boudoir drawing-room, fitted with lounging chairs and couch, all upholstered in a rich figured repp, and a walnut table. The sliding doors are covered with the same material, relieved with gold moldings. All the inside woodwork is polished walnut. The sides and ends are covered with a Lincrusta dado about 3 ft. high, of a rich chocolate color, the remaining portion, together with the roof, being covered with Lincrusta work in cream and gold, and fastened with polished walnut moldings. All around this apartment are views of lake scenery, etc.; in red carbon. The light is said to be excellent; and at night the room is illuminated by two 10 in. lamps from the roof. The floor is covered with a Wilton carpet. The next and last sliding door opens into a *coupé* in which are two lounge chairs upholstered in the same material as the saloon. A good view of the country is obtained from the two windows at the side and three at the end. The saloon runs on 6 wheels, and, in addition to the ordinary springs, is slung on suspension links with indiarubber rings as a supplement to the springs.

The New Terminals of the Pennsylvania Railroad at Jersey City.

(*Concluded from page 279.*)

THE PASSENGER STATION.

The general design of the new passenger station which is to replace the old one that had done service for so many years has been decided upon. It is located on the east end of the trainshed with its center a little south of the center line of the train-

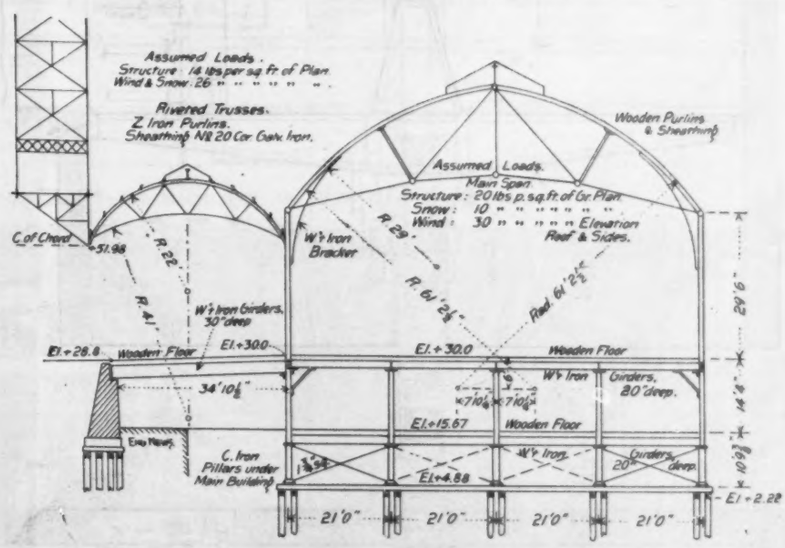


Fig. 5. Cross-section of Passenger Station, Showing Iron-work.

shed, as shown in Fig. 4 in our last issue. The old building had only one story; but the trainshed tracks being now at an elevation of about 15 ft. above the street level, the new structure will have two stories, of which the upper floor will be the one chiefly used by travelers, the lower story being only for Jersey City passengers, ferry waiting rooms, storage, offices, etc.

The station proper covers a space 188 ft. x 84 ft., and a covered passageway about 41 ft. wide extends along the side toward the trainshed and across each end. The passageways across the ends of the waiting-room permit passengers to pass directly from the ferries to the trains or in the contrary direction without passing through the waiting-room.

Like the trainshed, the station is founded on piling; but there is a considerable depth of water here, so that the placing of masonry to carry the structure from below low water mark to above high water mark would be expensive. Moreover, the foundation secured by piling at this point is not especially stable, and as little weight and as much flexibility as possible in the structure to be supported are desirable ends to be attained. The piles, which are driven in clusters of four, are therefore cut off below low water mark, and are capped with a timber platform which supports a cast iron column 7 ft. 8 ins. high. Tie rods 1¾ ins. square brace these columns, as shown in Fig. 5. On top of these columns 20-in. wrought-iron girders run across the building, and on these the floor timbers are laid. The floor of the second story and the roof are supported on iron columns.

The passages across the ends of the station are supported on piles cut off just below the level of the lower floor and braced with timbers. The roof trusses over these passages are similar to those over the transverse platform, shown in Fig. 5. It will be seen that this latter truss is supported on one side by the lower chord of the truss which runs across the gable of the trainshed (shown on our inset sheet last week to larger scale). This leaves an open space free from columns and 65 ft. in width across the whole end of the trainshed, a very desirable feature for handling large crowds.

As the teredo sometimes works in these waters all the piling and timber used in these foundations have been well creosoted.

The allowable working stresses in the iron work for the station are 14,000 lbs per sq. in. for wrought iron in tension; 13,000 lbs. per sq. in. for wrought iron in compression, properly reduced; 10,000 lbs. per sq. in. for single shear on rivets; 20,000 lbs. per sq. in. for bearing value of rivets. Where strains include wind and snow, the above tensile and compressive stresses may be increased to 17,000 lbs. and 16,000 lbs. respectively.

As in all the other work connected with the improvement of these terminals, the time and expense of constructing the station are considerably increased by the necessity of providing temporary accommodations for the heavy traffic, which must be moved with the least possible hindrance no matter what changes are going on. While the trainshed tract was being filled and the structure itself was being erected, the passenger trains were handled on parallel tracks on the old level, located on the tract just north of the trainshed. While the new station is being put up, travelers are accommodated in a waiting-room occupying the north end of the transverse passageway between the tracks and the waiting-room. This temporary station is built of cheap lumber, unpainted; but it had to be fitted up with all the various ticket offices, etc., as much as if it were to be occupied for years.

OTHER FEATURES OF THE TERMINALS.

The headquarters of the New York division of the Pennsylvania R. R. are at Jersey City, and the old office building in which the staff was quartered had become inadequate to their needs and unsuited for their comfort. A new five story office building is therefore being erected and is now near completion, occupying a space 50 × 150 ft., adjoining the east end of the trainshed on the south side, as shown in the general plan in our last issue.

The present ferry-house will remain unchanged

except that the roof will be raised and a system of bridges and passages will cross the ferry-house on a level with the second story of the waiting room and connect with foot bridges at each slip leading to the upper deck of the ferry-boats. The bridges leading to the lower decks are supported on pontoons, so that they adjust themselves to the rise and fall of the tide. The upper deck bridges, however, being only for foot traffic, are very light; they are suspended from the gallows frame, and are counterweighted so that they are easily adjusted by hand by the ferry attendants to suit the stage of the tide.

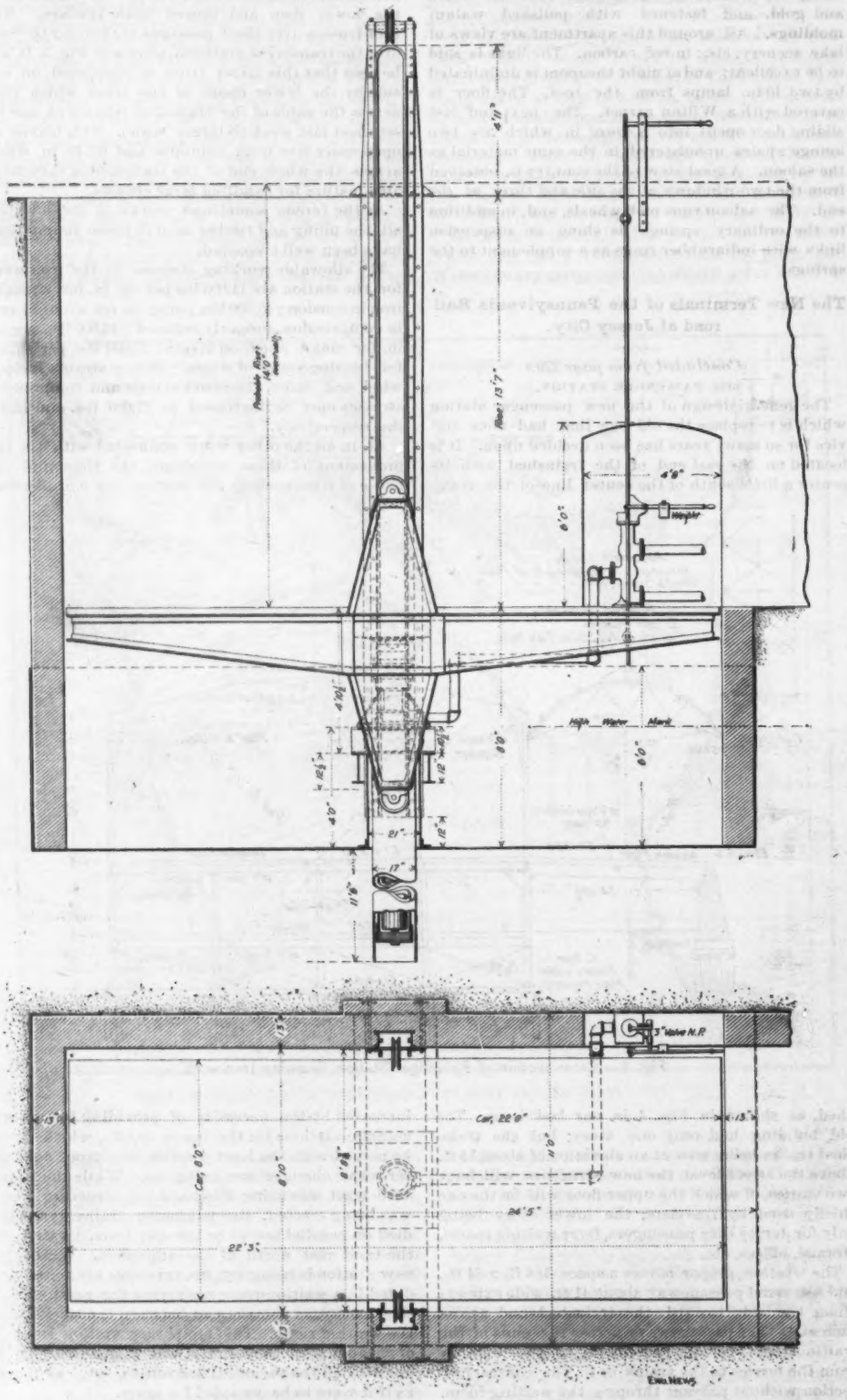


FIG. 6. HYDRAULIC ELEVATOR FOR BAGGAGE TRUCKS.

THE DOUBLE DECK SYSTEM OF HANDLING TRAFFIC.

Getting to and from the ferries which connect the railways terminating in Jersey City with New York has long been a disagreeable feature of travel for passengers leaving or arriving at New York by these roads. At the morning and evening hours there is a rush of suburban travel as well as a crowd which patronizes the ferry only. On the New York side, West St., which runs along the North River water front, is kept in a state of chronic blockade by long lines of trucks and other vehicles. Moreover it is deep with mud in wet weather and with dust in dry. On the Jersey City side, travelers, commuters, and the trucks and vehicles of every class which cross the ferries are turned loose in the ferry-house, and all seek their respective destinations, the foot passengers dodging the teams as best they can. To women, children, or strangers unfamiliar with their route, the noise and confusion and the crowds of people hurrying in different directions are bewildering enough.

But under the system of handling traffic which will be followed when the Pennsylvania's terminal improvements are completed, the annoyances above described will be largely done away with. The traveler leaving New York by the Pennsylvania R. R. will cross West St. by a covered bridge, enter the second story of the ferry-house and proceed thence over the upper bridge to the upper deck of the ferry-boat. On the Jersey City side he will pass over the passages and bridges in the ferry-house to the waiting-room, and thence to his train standing in the trainshed on the same level. The cabins on the lower decks will be chiefly used by the ferry passengers; and the relief from the overcrowding which is common at present in the rush hours on all the ferries will be a benefit of no small proportions. Baggage of course comes across the river on the lower decks, in a baggage van or on a truck, and is drawn through the ferry-house and onto the platform of a hydraulic elevator at the rear of the trainshed, which raises it quickly to the level of the trainshed platforms.

Fig. 6 shows a plan and side view of this elevator, which was furnished by the Stokes & Parrish Elevator Co., of Philadelphia. It is a direct acting machine, with a plunger 10 ins. in diameter. The total height of lift is about 14 ft. The elevator is furnished with water by a duplex pump connected to an accumulator, which, whenever it is started down by the use of water for the elevator, opens the throttle and starts the pump. The motion is thus automatic, and very little attendance is required.

The most interesting feature of the elevator is the means adopted in making the pit for it to keep out the salt water, the lower part of the elevator being necessarily below high tide. A big rectangular box was made, of tank iron, ¼ in. thick, and in this the masonry walls of the elevator pit were built, as shown in the drawing. A hole was left in the center of the tank, and a 14-in. pipe was driven down in this to contain the plunger and pressure chamber of the elevator. Tight joints were made everywhere, the top of the iron tank is above high tide, and no salt water can prevent the elevator from discharging its duties.

We have before spoken of the topography of Jersey City as being unfavorable for the construction of commodious railway terminals except at large expense. From our description of the foundations of various structures it will be seen that the soft silt which lies deep along the whole water front has really been a greater obstacle to the work than was the hard trap rock of the Bergen cut. Nevertheless judicious engineering has overcome these obstacles, and above this mud marsh has been placed the greatest trainshed in the world, covered by a roof whose span is greater (with one exception which we have elsewhere noted) than that of any building in existence. The system of handling ferry traffic which we have above outlined will be watched with interest by railway managers; and the innovation thus introduced seems likely to find favor in other quarters.

The Plant of the Berlin Iron Bridge Co. at East Berlin, Conn.

As many of our readers know, the Berlin Bridge Co. has for some time paid special attention to the construction of machine shops and other buildings for manufacturing purposes; and the iron work for a large number of important manufacturing plants erected during the past three or four years has been designed and built by the company.

Not long ago the managers of the company came to the conclusion that the experience gained in building shops for other people might be turned to profitable account in designing a shop for their own use.

The old plant of the company is situated on the west side of the Mattabassett River, in the town of Berlin, Conn., and comprises about five acres of land well covered with buildings; but, like a large class of the manufacturing plants in this country, the buildings were originally designed for a limited output; and as the business of the company has extended from year to year, additions have been made until the original buildings have sunk into insignificance and the additions comprise the greater portion of the plant. Owing to the limited amount of land available, the company decided to build their new plant on the east side of the Mattabassett River in the town of Cromwell, connecting it with

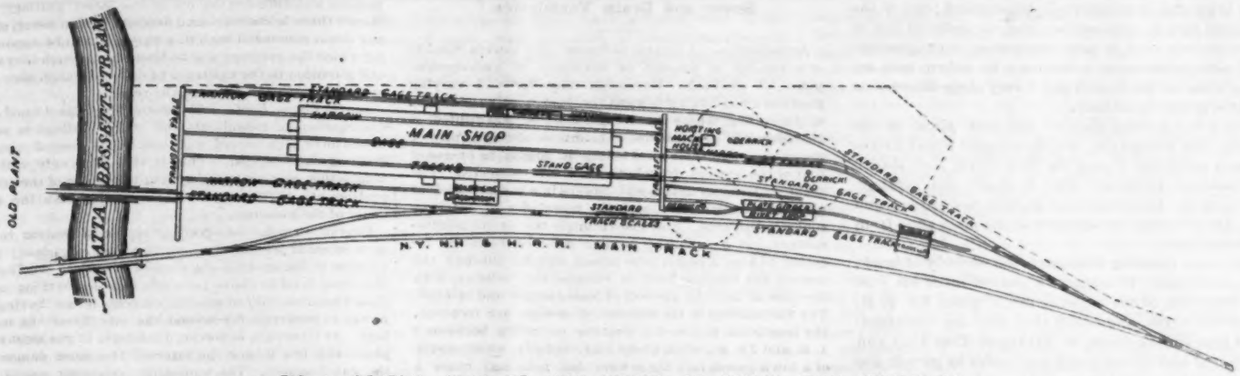


FIG. 1. GENERAL PLAN OF NEW WORKS OF BERLIN IRON BRIDGE CO

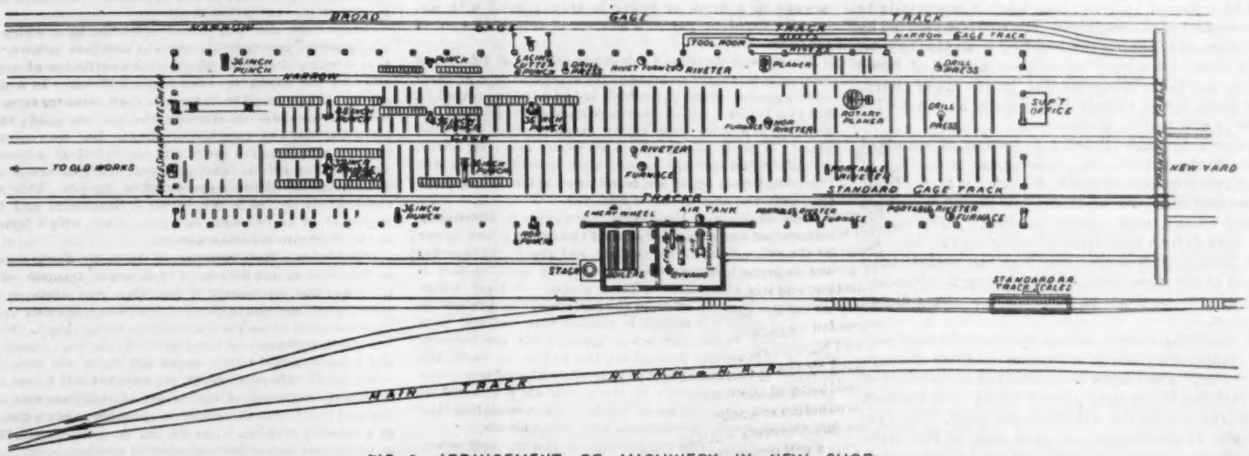


FIG. 2. ARRANGEMENT OF MACHINERY IN NEW SHOP.

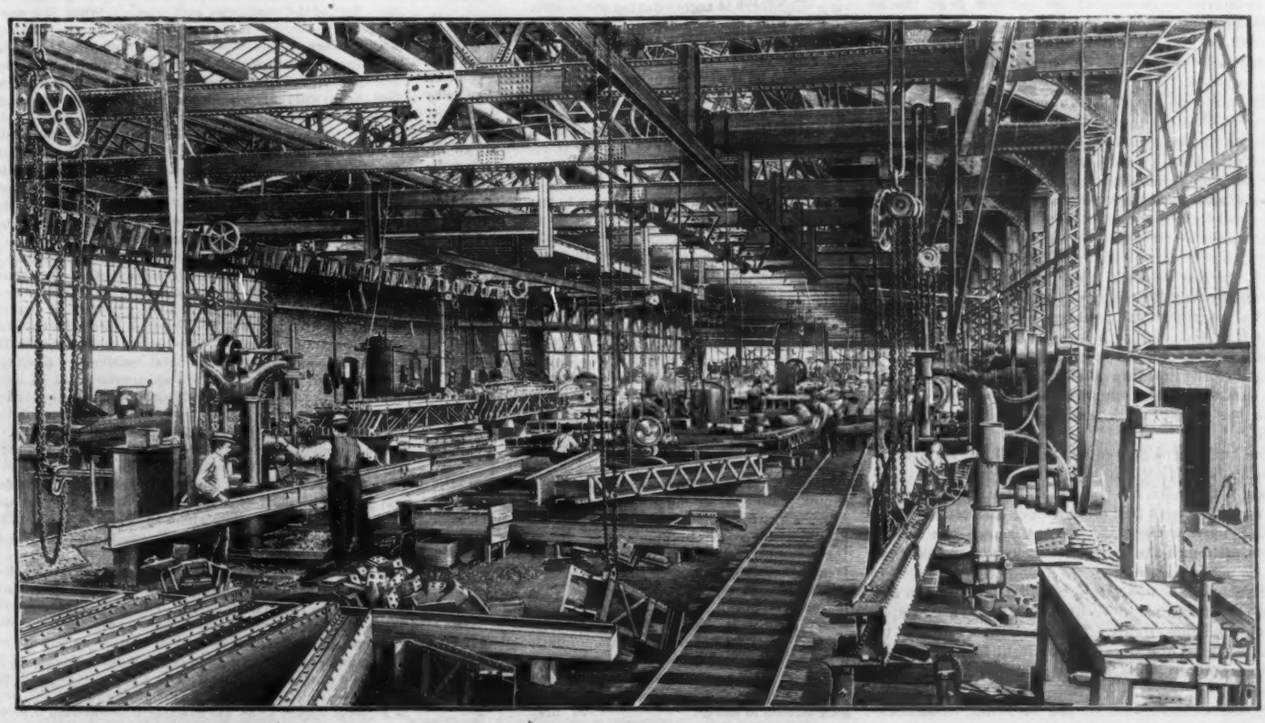


FIG. 3. VIEW OF INTERIOR OF NEW SHOP

the old plant by an iron bridge of sufficient capacity to not only carry the narrow gage cars which move their material about the premises, but also to carry an ordinary standard gage locomotive and loaded cars.

In the designing and construction of manufacturing plants the three great objects to be kept in view are to reduce the cost of manufacturing the product to the minimum; to reduce the cost of maintenance and repairs to the minimum, and to reduce the first cost of building to the minimum.

Many manufacturing concerns reverse the order, and reduce the first cost of building to the minimum without regard to economy of maintenance or o manufacture. This is sometimes desirable in the manufacture of a class of goods where the profits are large and the capital is limited, so that in time cheap wooden buildings may be removed, and mod-

ern brick and iron buildings substituted; but if the reduced cost of maintenance and the reduced cost of manufacture due to more convenient arrangements and more permanent structures be taken into account, the saving would pay a very large interest on their original extra cost.

Fig. 1 is a general plan of the new plant of the Berlin Iron Bridge Co., which occupies about 3 acres of land along the line of the New York, New Haven & Hartford Railroad. Fig. 2 shows the arrangements of the machinery in the shop and yards; and Fig. 3 is a view of the interior of the main shop from a photograph.

The main building is constructed entirely of brick, iron, and glass. It occupies a ground space 400 × 80 ft. The sides of the building are of glass for 10 ft. below the eaves, and below that they are constructed of iron sliding doors, so arranged that they can be opened and closed quickly in order to permit the entrance of material through the sides of the building when necessary. In summer these iron sides can be removed entirely, thus adding materially to the comfort of the employés. The roof is supported by iron trusses spanning the building from side to side. Each truss is designed to support a load of 10,000 lbs. at any point along the line of the lower chord, and these lower chords are utilized as tracks for trolleys and traveling cranes.

As seen by Figs. 1 and 2, a system of standard gage tracks permits the economical unloading of stocks or shipment of finished work. At the front of the building two jib cranes are placed, by which a load on any track can be handled. These cranes are worked by a four drum hoisting engine, built by J. S. Mundy, of Newark; one man can operate both cranes at the same time. The shipping facilities are such that 10 cars can be loaded in a working day of 10 hours.

The building itself is served by three lines of narrow gage tracks, one on each side and one through the center. The tracks are connected at each end of the building by transfer tables, which also connect these tracks with the tracks in the yard. The raw material is distributed on each side of the main building direct from the cars; and after being sorted, it is moved by means of the narrow gage tracks into the north end of the shop (the end shown on the left of Figs. 1 and 2) where it is laid out from templates, trimmed at the shears, and prepared for the punches.

The punches are all arranged with a "drop motion," so that the punch can drop down on the work and enable the operator to find the center mark and punch the hole exactly in the proper place. From the punches the material goes to the riveting machines, and from the riveters to the planers, drills, etc., and thence out at the south end of the shop, so that under no circumstances is there any reason for work to pass except in one direction through the shop, the raw material coming in at one end and the finished product passing out at the other.

The interior of the building is lighted, as above noted, by the windows on the sides, and there is also in each side of the roof running the whole length of the building a skylight 12 ft. long. Thus the entire length of the building is so well lighted that the finest work can be done in any part of it.

The building is heated by the well known Sturtevant system of hot air with forced draft. All furnaces, both under the boilers and for rivet heating, are equipped with fuel oil burners; and crude petroleum is used entirely for fuel through the whole plant, although the boilers are so arranged that coal can be used if desired.

The works are lighted by a Thomson-Houston dynamo with 250 incandescent lamps and 12 arc lamps, all on the same circuit. The arc lamps are used to light the yard and give general light for the shops, while there are two incandescent lights at each machine.

In the construction of the building, woodwork and inflammable materials are not used, hence there is absolutely no risk from fire, and the company is not obliged to carry any insurance, as there is nothing about the building which can in any way take fire and burn. Moreover, the construction being of iron, the only repairs necessary to keep it in good condition is an occasional painting. With this arrangement the cost of maintenance is apparently reduced to its lowest limits.

Sewer and Drain Ventilation.*

Introduction.—A system of drains and sewers consists of a number of lengths, or branches, of underground pipes, of gradually increasing diameter and varying gradients, converging toward the lowest point or outfall of the system, where the sewage, more or less diluted, is discharged by gravitation. The drains are the units of the system, and their total length is largely in excess of that of the sewers, to which they are connected. The great majority of drains and sewers in a town consist of glazed stoneware pipes, and the remainder of brick or concrete culverts. The flow through the drains is intermittent, but a sufficient number are always in use together to keep a continuous stream flowing through the sewers, but varying, both in volume and velocity, with the time of day, the amount of water supply and rainfall. The fluctuations in the volume of sewage are frequent, the maximum flow in dry weather occurring between 9 A. M. and 2 P. M., when about half the daily water supply of a town passes into the sewers; but rain may cause a sudden or gradual increase at any time.

Sewer Always Full.—The remaining space above the sewage in a drain or sewer is always filled with air, watery vapor, or gas, or a mixture of at least two out of the three.

Minimum Velocity.—A minimum velocity of 180 ft. per minute is necessary to prevent the deposit of solid sewage unless special means of flushing are adopted to prevent it; but this velocity will discharge sewage at the outfall from any part of a town long before decomposition can take place. When solid deposit occurs in any drain or sewer, decomposition quickly ensues, and sewer gas, as distinguished from sewer air, is produced in increasing quantity, until the obstruction is removed.

Compression and Expansion.—Sewer air is alternately compressed and expanded against the crown of the sewer by the rise and fall of the sewage, and also by the increase and decrease in barometric pressure; the latter action is particularly observable before a storm. Watery vapor is constantly given off from the surface of the sewage as from any other wet surface in contact with air; and both the watery vapor, and sewer gases, if any are present, diffuse themselves throughout the sewer air until the point of saturation is reached in an unventilated sewer; the percentage of moisture in the sewer air is lowered by ventilation, and the more perfect the ventilation the nearer the sewer air compares with the outer air.

Temperature.—The temperature of sewage and sewer air is generally lower than that of the outer air during the summer, and higher during the winter.

Forces at work.—Motions of sewer air are produced by compression, expansion, diffusion, differences of temperature, and barometric pressure; these motions cannot be measured by the anemometer, but are made visible by the condensing of the watery vapor in cold weather, or by the introduction of smoke.

Down-hill Currents.—A velocity of 180 ft. per minute in the sewage will generally carry the sewer air down hill with it, and the motion is accelerated by every intermittent discharge from the drains.

Wind.—The most powerful agent in producing motion in the sewer air is the wind, which acts by inducing a vacuum in, or by blowing directly into, any opening in the sewers or drains, according to the position of the opening, and the direction and force of the wind.

Unventilated Sewers.—All attempts to keep sewer air and gas bottled up within the sewers and drains having failed, ventilation was reluctantly adopted, for want of something better; and it is now a generally recognized fact that unless some provision is made to ventilate sewers and drains, they will ventilate themselves.

First Ventilation.—The first ventilation was most probably unintentional, by untrapped rain-water pipes and by overflow pipes from rain-water cisterns becoming untrapped in dry weather and allowing sewer gas into houses.

Street Gratings.—To relieve the pressure upon the drains, manholes, at long distances apart, were ventilated by open gratings at the street level, and these have been gradually increased in number and area of openings, on the assumption that the nearer the approach to an open trench the better, and now they are placed from 40 to 200 yds. apart and the openings range from 30 sq. ins. to 72 sq. ins. area. This method of ventilation by gratings at the street level only simply provides overflows or safety valves to prevent too great an accumulation of gas; but it is vent only, without ventilation, as the movements of the sewer air are very slow, feeble and uncertain, unless there is a good wind, a rising barometer and a fast running stream of sewer.

The difference in height between any pair of adjacent gratings at the street level is generally so small that there is no marked tendency for either to become an inlet, in preference to an outlet, and puffs of wind may make them act feebly both ways, within a few seconds, without greatly affecting the air within the sewer. With a falling barometer the watery vapor and sewer air acting by expansion and diffusion rise out of the street gratings, and should there be decomposing deposit in the sewer, or in any drain connected with it, a nuisance will be apparent for which the gratings will be blamed, although they only call attention to the existence of defects which they did not cause and can only partially remedy.

Shafts above Roofs with Street Gratings Closed.—In consequence of complaints the street gratings in some towns have been closed, and iron pipes erected against buildings substituted. This is still vent, only without ventilation, and a reproduction of the action of the street gratings at a higher level, without dealing with the first cause of the nuisance.

Partial Ventilation.—Neither system of venting to relieve internal pressure by inducing a mere tendency to a vacuum in the mouths of a number of outlets, whether at the street level or above the roofs, can be anything more than a manufactory of gas, the currents of air having no power to penetrate far beyond the mouths of the openings. At intervals, however, discharges of gas must take place, and the longer the interval the more dangerous the gas becomes. The constantly changing conditions under which a system of sewers and drains act are such, that it is as impossible to stop at partial ventilation as it is to have no ventilation at all.

Comparison with a Mine.—The leading idea, which for a long period governed attempts to ventilate sewers, was that it was a similar problem to the ventilation of mines, whereas the conditions are entirely different. In a mine all the air entering the down-cast shaft must traverse the workings and pass out through the up-cast shaft, these being the only two possible openings. But any attempt to draw air through a sewer will not be felt at a greater distance than 400 yds., and only under very favorable conditions will the distance exceed 100 or 200 yds. This was conclusively proved in 1858, by Sir J. Bazalgette and Col. Heywood, by experiments on a large scale, with a furnace at the Westminster clock tower.

Wimbledon.—More recently, in 1887-8, Mr. Santo Crimp, at Wimbledon, had 600 yds. of 12-in. sewer trapped off at the lower end, an opening 28 ins. area was made at the street level, just above the trap, and a 6-in. opening at the upper end; all other known openings being closed. There was 100 ft. difference of level between the two openings, and a fan attached to the upper one drew air from the sewer at the rate of 300 cu. ft. per minute for 14 hours, and during the same period the sewer air continuously discharged itself from the lower opening, 600 yards away, at a velocity of 42 lin. ft. to 104 lin. ft. per minute, thus showing that one or more accidental openings must have existed, and that the friction of the flow of sewage, and the effect of the wind, was sufficient to bring the sewer air down to the lower opening, in spite of the powerful fan at work at the upper end. On removing the fan the 6-in pipe was carried up a building 25 ft. high, and anemometers attached to the lower opening showed that during 1888 the air current was down hill at that point on 273 days and up hill on 97 days. Unfortunately no anemometer appears to have been used at the shaft at the upper end.

Notwithstanding these facts, the favorite recommendation by newspaper correspondents has always been to connect to a factory chimney, on the assumption that it will entirely clear a whole system of sewers and cremate the gases. Factory chimneys are usually confined to one quarter of a town, and although velocities from 500 ft. to 2,000 ft. per minute can be obtained by connecting to them—and in some towns costly stacks 100 ft. high have been specially erected for the purpose—their effect upon ordinary sewers is only local and very limited in extent; so that it is like shooting at a sparrow with a 100-ton gun.

Keeling's "Destructor."—The most recent apparatus for ventilating sewers by artificial means is "Keeling's patent sewer gas destructor," an arrangement of lamp column with a 6-in. connection from the sewer for passing sewer air through an atmospheric gasburner fixed in the base of the column, the outlet being about 10 ft. above ground under an ordinary street gas lamp placed at the top of the column; a consumption of coal gas from 6 cu. ft. to 10 cu. ft. per hour is required to keep them burning and produces a heat of about 600° F. at the burner and about 100° F. at the outlet, where the velocity is about 200 ft. per minute, or equal to about 40 cu. ft. per minute of air extracted.

The advantages claimed for this apparatus are that sewer gas is entirely cremated, and that one destructor will suffice to ventilate fabulous lengths of 12-in. sewer, variously stated, or inferred, as somewhere between 1,000 yds. and nine miles; but no such distances can be affected by any such apparatus if a fan or a factory chimney of 10 times the power cannot do it. The apparatus costs about £15 fixed complete, and about £10 per annum for gas, and is a useful luxury as an aid to natural ventilation if properly applied at the lower end of a sewer, instead of at the upper end, as recommended by the patentee. Their greatest use is for dealing with the emanations from a very foul sewer; but this is treating the symptoms of the disease, instead of the disease itself, for such a sewer requires reconstruction first, and ventilation afterward.

True Ventilation.—Nearly all attempts to maintain a constant current of air flowing in one direction have failed, because they have not been in harmony with the forces at work within and without the sewers. The

* By R. Read, Assoc. M. I. C. E., M. S. I., City Surveyor, Gloucester. Read before the Congress of Hygiene and Demography.

streets are the only places where municipal authorities are free to ventilate sewers as they please; therefore, the gratings at the street level have always been more numerous than shafts above the houses; and as long as this is the case no constant current of air inwards at the street gratings can be maintained. There can be no true ventilation without a system of both inlets and outlets; the street gratings should be comparatively small to always act as inlets, and the outlets should always be above the roofs of the houses, and much more numerous than the inlets. It is necessary, therefore, in order to give a strong initial velocity at the inlets, and to localize the ventilation, that the street grating inlets should not exceed 30 or 36 square inches area, placed from 60 to 100 yards apart, and that the outlets should be distributed over these lengths in such members of 4-in. or 6-in. shafts that the sum of their sectional areas, between each pair of inlets, shall exceed the sectional area of the sewer as much as possible.

Ventilation by Drains.—This arrangement can only be obtained by terminating every house drain by a 4-in. soil-pipe, or 6-in. shaft, carried above the roof as an outlet with no obstruction between it and the sewer; the fresh air will then constantly enter at every street grating, with a minimum velocity of 100 to 200 ft. per minute, travel down the sewer with the sewage, and up every drain and outlet pipe or shaft above the roofs. Each length of 60 or 100 yds. of sewer between a pair of inlet gratings, and all the drains connected therewith, will then be thoroughly ventilated by a localized continuous current which cannot be reversed, and which will require no traps, flaps, valves, or other obstructions, except at the gullies and w.c.'s, to isolate or direct its course; the velocity of the current will only increase with the wind, from whatever quarter it may blow, and sewer gas will have no chance of existence.

Interceptors.—The above system requires the abolition of the so-called "Interceptor" traps, which obstruct the flow of the sewage, and render the true ventilation of the sewers impossible. They are the only form of unventilated syphon trap now tolerated, and oppose the inertia of about three gallons of stagnant sewage to each discharge through the drain; this sewage in the "Interceptor" never gets entirely changed, and is constantly manufacouring gas on its own account and providing a greater danger to the inhabitants of the house than the sewer to which the drain so trapped is connected.

Flushing.—Every w. c. should be provided with a mechanical apparatus, or cistern, for flushing after each user, to keep the drains properly clean in the intervals between rainfall, because the water so applied must of necessity pass through both drains and sewers, while whatever the quantity of water used by the municipal authorities for sewer flushing it can only pass through the sewers, leaving the drains untouched, and thus wasting a large quantity of water which would be more usefully and economically employed if passed through the drains as well as the sewers.

Object of Ventilation.—The true object of sewer ventilation is not to let out at intervals quantities of sewer gas of increasing foulness, but to introduce into properly constructed sewers and drains such a constant current of air, as will prevent the formation of gas altogether. The systems of partial ventilation now in use, merely provide sufficient oxygen to facilitate the formation of gaseous compounds, without rendering them harmless.

A STORM RAIN GAGE, which will be acted upon by the force of the wind and tilt forward the mouth of the gage toward a slanting rainfall, is suggested by a correspondent of The *Engineer*. The general form is that of a marine rain gage. The vessel is 6 ins. in diameter and 12 ins. high, with a bottom formed of a long cone with its apex above the middle point of the height. This cone forms a universal pivot for a pointed support. In calm weather the mouth of this gage would be horizontal. But with a strong wind blowing the base would be pushed out with the direction of the wind and the mouth tilted toward the slanting rainfall. The water falling would lie in the annular space around the cone, and would have to be measured off by the usual glass, or the vessel itself could be graduated.

AN ADDITIONAL WATER SUPPLY FOR EDINBURGH is reported upon by Messrs. GALE, HILL and MANSERGH, the engineers appointed to investigate the problem. They presented three projects. The first takes the supply from the headwaters of the Manor, with a drainage area of 13,720 acres, 15,000,000 galls. per day supply, 25 miles of conduit and costing £842,440. An alternative scheme proposed is also from the Manor, with the same drainage area and supply per day and to cost £873,005. The second scheme is to obtain water from the Tweed with 36 miles of conduit, 12,175 acres of drainage area and at an estimated cost of £833,000. The third is the St. Mary Lock scheme, with 25,500 acres of water-shed, 35½ miles of conduit and to cost £879,000. The commission of engineers recommends the first Manor River project as the nearest and including the best water. The plans provide for double the present population of Edinburgh, at 38 galls. per day per head. Another note on this subject was given on page 271.

THE COAL PRODUCT OF THE UNITED STATES, for 1890, says Census Bulletin No. 10, was 141,229,513 short tons, and this was valued at $160,226,323 at the mines. This output included 45,600,487 short tons of anthracite, worth $65,879,514; and 95,629,026 short tons of bituminous and lignite valued at $94,346,809. The average value of all salable grades of anthracite coal was $1.58 per ton at the mines, and the average for bituminous was 99 cts. per short ton at the mines. As compared with 1880 the output stood:

	Anthracite. Short tons.	Bituminous. Short tons.	Value at mines.
1880.....	28,649,812	42,831,758	$95,640,396
1890.....	45,600,487	95,629,026	160,226,323

The product increased 97.57% in the decade, and the price increased 67.53% in the same period. The total number of persons employed in coal mining was 299,559, and $109,130,928 was paid out in wages. This bulletin gives excellent maps showing the location of the coal fields, the production of coal, etc., and the time necessary for preparing maps probably accounts for its long delay in appearing.

A COMBINED RACK AND ADHESION RAILWAY is to be built in Switzerland to the top of the Santis, the highest peak of the northeastern range of the Alps. It will be a narrow gage line, 10 miles long, from Appenzell to its terminus at a point 7,635 ft. above sea level, and the Abt rack-rail system will be used on the mountain section. The cost is placed at $825,000.

FORTIFICATIONS BUILT IN 24 FT. OF WATER, and covering about 16 acres, call for some interesting work at "Middelgrund," near Copenhagen. These works are about 3 miles from the coast and include breakwaters on the north covering an arc half a mile long and rising 8 ft. above the water. To form the foundation and to protect the base of the walls 240,000 cu. yds. of stone were required. On this stone timber caissons, 45 ft. long, were floated into position and then sunk by filling with stone. On these caissons concrete blocks were set extending from 3 ft. below low water to 1½ ft. above, and on this is a granite wall 12 ft. thick at the base. The pier at the south end is built of concrete blocks, 18 ft. thick, and is protected on the outside by rip-rap. A basin 60 ft. wide and 9 ft. deep for torpedo boats has been formed inside. The forts proper cover 9 acres, and the material for filling has been obtained by dredging the south entrance to Copenhagen. The guns, 17 in number, will be elevated 45 ft. above the water and be protected by armor shields. Behind the battery, earthworks rise to a height of 70 ft. above sea-level and a lighthouse 20 ft. high tops this.

CONSTRUCTION NEWS.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

Portland & Rumford Falls.—The contract for building the proposed extension of this railway from Gilbertsville to Rumford Falls, Me., 14⅜ miles, has been let to Spofford & Mitchell, of Bucksport, Me. The work is to be first class in all respects, and must be completed by July 1, 1892.

Pennsylvania.—The contract for building the extension from Mann's Choice to Brook's Mills, Pa., 30 miles, is reported let to Colonel Hobart, of Vermont.

Pittsburg, Shenango & Lake Erie.—The city of Conneaut, O., has raised the required subscription of $25,000 in aid of the proposed branch of this railway to that place, about 11 miles long, and construction is now reported in progress.

New York, New Haven & Hartford.—The four-track system between South Norwalk and Bridgeport is nearly completed, and it will be opened for service in a month or so. There is still a little filling and digging away to be done at Green's Farms. The new strip is 14 miles long. Four tracks are yet to be put in between Portchester and South Norwalk and Bridgeport and New Haven. The work is now under way between Portchester and Greenwich, an 8-mile strip. The work will first be finished to Stamford, and within a year probably it will be completed up to that point, with all the grade crossings taken out. In Bridgeport the four tracks have been completed as far as Barnum's siding, where the elevated structure through the town will begin.

Baltimore & Ohio.—The work on the extension to connect with the Virginia Midland R. R. at Fairfax Station, Va., has commenced on the Maryland side. The surveys for this connection were made some time ago, but active work has been delayed. The road extends from Knowles Station, on the Metropolitan Branch, in Montgomery Co., Md., to the Potomac River, near the Chain Bridge, in the District of Columbia. The river will be bridged at this point. Reaching Virginia the line will follow Pimmet Run to Langley, and thence on to Fairfax Station. When completed it will effect a southern connection for this road through the Richmond & Danville system.

Lehigh Valley.—This company has announced that it will use its new line into Buffalo for all traffic after Jan. 1, 1892.—A four-mile branch to the Silver Brook Colliery, near Bethlehem, Pa., will be built by this company.

Adirondack & St. Lawrence.—This company will let contracts for building its proposed line in New York. Profiles and specifications can be seen at the Gilsey House, New York City. Address Newman Erb or James P. McDonald.

Iron Range & Huron Bay.—About 40 miles of grading have been completed on this railway from Huron Bay to Champion, Mich., 60 miles. It is expected to have 12 miles of track laid by Jan. 1, 1892.

New York, Lake Erie & Western.—The citizens of Salem, O., have raised $50,000 in aid of the extension of the Niles & Lisbon branch of this road to that place. The proposed line would be about 5 miles long.

Projects and Surveys.

Chesapeake & Columbia.—This company contemplates the construction of a railway from Washington, D. C., to Annapolis, Md.

Westchester & Putnam.—Incorporated in New York to build a line of railway from the Sunk Mines, Putnam, N. Y., to the Hudson River. Among the incorporators are Thos. A. Edison, Orange, N. J., and Chas. Batchelor, 33 West Twenty-fifth St., New York City.

Bath, Small Point & Popham.—The surveys have been commenced for this railway from Bath to Fort Popham, 20 miles, under the direction of P. H. Richardson, of Portland, Me. J. A. Bradbury, President, Saco, Me.

Hinesburg & Essex Junction.—It is stated that surveys are being made for a railway from Hinesburg to Essex Junction, Vt.

SOUTHERN.—Existing Roads.

Western Maryland.—Tracklaying has been commenced on the 14-mile line from Williamsport, Md., to Cherry Run, W. Va.

Ashley River.—About 1 mile of track has been laid on this railway at Charleston, S. C., and 150 men are now at work.

Richmond, Nicholasville, Irvine & Beattyville.—A construction company has been organized to complete this line to Beattyville, Ky.

Atlantic & Florida.—According to the newspaper reports this company has secured the money necessary to extend its line to the Atlantic coast. Several lines are reported to have been surveyed, but no selection has yet been made.

Atlantic Coast Line.—Grading has been completed on the line from Fayetteville to Rowland, N. C., 40 miles, and as soon as the bridging and trestling is finished tracklaying will begin.—Construction has been commenced on the line from Greenville to Washington, N.C., 20 miles.

Fincastle & Cloverdale.—Grading on this railway from Fincastle to Cloverdale, Va., 6¾ miles, will be completed by Oct. 10, unless delayed, and tracklaying will begin as soon after as possible.

Macon & Atlantic.—The construction of this line from Macon, Ga., to the Atlantic coast is not proceeding very rapidly. Notwithstanding the reports made some time ago that all the money necessary had been secured the company is stated to be badly in debt. The promoters are making endeavors to adjust these difficulties and hope to be able to push work more rapidly.

Louisville & Nashville.—It is stated that contracts will soon be awarded for building the proposed extension of the Birmingham Mineral R. R. from Oneonta to Huntsville, Ala.

St. Louis & Birmingham.—Geo. R. Johnson, General Manager, writes to the *Manufacturers' Record* that a corps of locating engineers was put on the route on Sept. 15, and contract is now let for 12 miles of grading between Florence, Ala., and Clifton, Tenn., to Lane Bros. It is expected that another force of men and teams will be put to work on the road in a short time. L. S. Proctor is Chief Engineer.

Projects and Surveys.

Halifax & Indian River.—Robbins & Graham, of Titusville, Ga., have sent us the following information concerning this railway:

This road is projected to run from Daytona, Fla., via Port Orange, Spruce Creek, Glencoe and La Grange, to Titusville, Ga., 45.6 miles. A preliminary survey was made in August and location will probably begin in December. The work will be light; maximum grade 0.7% and maximum curve 3°. It is expected to secure $20,000 in land and right of way from the people along the route. The contracts for grading, bridging and cross-ties will be let to local contractors, but the company wishes to get

bids on rails and rolling stock. It is intended to have the road completed by Nov. 1, 1892. The company was chartered Sept 4, 1891.

Phosphate Railway Co.—This company has been chartered in Florida by W. H. Adams, C. M. Brown, A. C. Quarrier and others to build railway lines.

Brooksville & Lacoochee.—The locating surveys have been completed for this Florida railway and the estimates will soon be ready for contractors. L. V. Jenness, Brooksville, Fla,. President.

Charleston, Clendennin & Sutton.—At a recent meeting of the stockholders of this company it was decided to begin the location of the line at once. It is stated that the people along the route are subscribing liberally in aid of the line. President, F. W. Abney, Charleston, S. C.

Georgia.—The following railway companies have filed certificates of incorporation with the Secretary of the State of Georgia: Atlanta, Hopeville & Manchester R. R. Co.: from Atlanta to Hopeville; capital stock, $100,000; C. W. Smith, W. R. Hammond, Atlanta.—Georgia Mineral R. R. Co.; Atlanta to Cherokee Co.; capital stock, $50,000; H. Smith, G. W. Adair, Atlanta.—Savannah & Ocean R. R. Co.; Savannah River, Chatham Co., to Oconee River, Laurens Co.; capital stock, $250,000; P. Smart, D. C. Bacon, Savannah.—Atlanta, Southern & Western R. R. Co.; Atlanta to Alabama line; capital stock, $100,000; H. L. Wilson, C. A. Evans, Atlanta.—Atlanta, Americus & Florida R. R. Co; Atlanta to Tampa, Fla.; capital stock, $100,000; N. B. Ousley, J. W. Hopson, Atlanta.—Georgia, Virginia & Baltimore R. R. Co.; Atlanta to Baltimore, Md.; capital stock, $100,000; W. A. Hemphill, B. M. Hall, Atlanta.—Bills have been introduced into the State Legislature chartering the Southern Air Line R. R. Co. and the Carrolton & Roanoke R. R. Co.—The Seaboard & Augusta R. R. Co. is reported to have been chartered to build a railway from Augusta to Tampa or Tallahassee, Fla.; C. L. Hague, Jesse Thompson, Augusta.

St. Petersburg & Gulf.—This company is to be chartered in Florida to build a railway from St. Petersburg to Disston, Fla., 8 miles. President, Capt. Patrick; Vice President, J. B. Pepper; both of St. Petersburg, Fla.

NORTHWEST.—Existing Roads.

Rapid City, Missouri River & St. Paul.—The surveys for this railway line have now been completed to Pierre, S. Dak. Work is in progress between Rapid City and the Cheyenne River with about 100 men and teams.

St. Louis, Alton & Springfield.—A press dispatch says:

Manager Fisher, of the St. Louis, Alton & Springfield R. R., has returned from New York, and reports the financial outlook for the contemplated extensions of his road as bright. In fact, he expects to begin work on the Alton-St. Louis and the Bates-Springfield extensions this season. A line into Calhoun County, for which a standing offer of $60,000 is tendered by the people of that county, is also contemplated, as is a line to Cross, Madison County, from Alton to Highland or Collinsville.

Wisconsin Bee Line & West Superior.—It is stated that this company has let the contract for the section of its line from Wausau to Merrill, Wis., to be completed within 6 months. C. W. Newton, of Fond du Lac, Wis., is Chief Engineer.

Pawnee.—Work is expected to begin on the extension of this railway to Auburn, Ill., 5 miles, in a few days. The line is to be completed by Dec. 1, 1891.

Kewaunee, Green Bay & Western.—The contract for building a branch from Luxembourg to Ahnapee, Wis., 18 miles, is reported let to J. A. McDougall, of Milwaukee, Wis. The main line from Green Bay to Kewaunee, Wis., 32½ miles, is now about completed. S. B. Fisher, Green Bay, Wis., Chief Engineer.

Minneapolis, St. Paul & Sault Ste. Marie.—Track laying on the Hankinson-Valley City extension has been completed from Hankinson to between Cuba and Lanona, N. Dak., and will be completed to Valley City by the first week in October.—The Boynton-Bismarck line has been extended 10.2 miles from Boynton to Merricourt, N. Dak.

Projects and Surveys.

Quincy, Keokuk & Chicago.—An official of this company is reported as saying that all arrangements have been made to begin construction, and that work would commence soon. The road is projected to run from Quincy to Niota, Ill., 50 miles, and will, it is stated, be operated in connection with the Atchison, Topeka & Santa Fe R. R. F. C. Horn, Exchange Building, Chicago, Ill., is Chief Engineer.

SOUTHWEST—Existing Roads.

Kansas City, Ft. Smith & Southern.—President L. L. Bush is reported as saying that this road would be extended to Ft. Smith, Ark., next season, without fail.

Texas, Louisiana & Eastern.—Kennedy & Stone, of Conroe, Tex., have advertised to sublet contracts for 40 miles of grading and cleaning on this Texas railway.

San Antonio & Aransas Pass.—The engineers which are surveying the extension of this railway from Giddings, Tex., to the mouth of the Brazos River, have reached Wharton, Tex., on the route.

Kansas City, Arkansas & New Orleans.—Articles of incorporation were filed at Little Rock, Ark., on Sept. 22, by the Kansas City, Arkansas & New Orleans Railroad Co., to build a road through Arkansas, from north boundary line of the state southerly about 300 miles through the counties of Baxter, Marion, Searcy, Stone, Van Buren, Cleburne, White, Prairie, Lonoke, Arkansas, Jefferson, Lincoln, Drew, Ashley, Bradley and Union. The incorporators are ex-Attorney-General Daniel W. Jones, Little Rock; Merritt H. Johnson, Little Rock; John Sims, Hazen, Prairie Co.; George W. Schnellbacher and George D. Foster, of Beebe. The capital stock is $6,000,000. It is understood that the company will acquire the controlling interest of the Stuttgart & Arkansas River Co., recently purchased by C. G. Stoddart, of New York City and London, and it will also acquire all of the rights and franchises of the projected Kansas City, Arkansas & New Orleans Railway Co.

Projects and Surveys.

Pierce City & Northern.—Organized in Missouri to build a railway from Pierce City to Mount Vernon, Mo., 16 miles. The preliminary surveys are in progress.

ROCKY MT. AND PACIFIC.—Existing Roads.

Great Salt Lake & Hot Springs.—Work on this line between Hot Springs and Bountiful, Utah, is making very good progress. This division will be ready for the rails in 30 days. Between Bountiful and Centerville considerable difficulty has been had in securing the right of way and little work has been done.

Coos Bay, Roseburg & Eastern.—Tracklaying has been commenced on this Oregon railway, and it is expected to have the line between Marshfield and Coquille City in a short time.

Southern Pacific.—It is stated that the San Bernardino & Redlands motor road, which is being changed into a branch for this road, will be extended to Crafton, Cal.—Work has been begun upon the 26-mile section between Yuma, Ariz., and Liguria, which is being rebuilt to avoid danger from floods.

Denver & Rio Grande.—Levi & Moore have the contract for building the Rio Grande & Gunnison R. R., noted last week.

Great Northern.—Track is being laid on the Pacific extension of this road at the rate of two miles per day. Contracts for 75 miles east of Bonner's Ferry, Mont., were recently let, and it is expected to have the line completed ready for rails to Bonner's Ferry within two months. On the line west of Bonner's Ferry work is being rapidly pushed. A contract for the remainder of the line to Spokane, Wash., will be awarded in a few days.

Northern Pacific.—The work on the Chehalis-South Bend line is being somewhat delayed by the wet weather. The most important work on the line is the big bridge across the Chehalis River. The contract for the iron span has been awarded to the San Francisco Bridge Co., which has arranged to begin work on the structure immediately. It will take about five or six weeks to complete this work. About 15 miles of track have already been laid, and it is said that the track may be laid the entire distance by the time the bridge is completed. Track will be laid as far as Pe Ell prairie before the end of next month. The approach of the rainy season is spurring the contractors to greater speed and considerable work will be done before November. After that time but little can be done on account of the rain. Ten miles of the road have been graded from the South Bend end of the line, and it is expected that about 5 miles will be graded within the next 8 weeks. Before the end of November it is expected that 30 miles of track will have been laid from Chehalis, and with 15 miles of the road graded eastward from the terminus there will be 11 miles of road left to be built. A contract has been let to G. E. Corey, of South Bend, for the erection of freight sheds at that place.—Tracklaying on the Ocosta branch has reached a point about 3 miles from South Aberdeen. The entire line has been graded and track is being laid at the rate of 2 miles a day.

Projects and Surveys.

Portland & Southern.—Two parties of engineers are now making surveys for this railway from Portland, Ore. It has not been definitely announced to what point the line will be built. It is reported that it will be built across the mountains to a connection with the Union Pacific at or near Huntington, Ore., and it is also stated that the company will ultimately connect with the Nevada-California-Oregon Ry., which wants a northern connection. It is stated that the company will build first to Marquam, in Clackamas County, a distance of about 35 miles. From there it will go through a pass in the Cascade Mountains, near Eagle Creek. From there on the route has not been definitely located. The road will be standard gage, and 60-lb. rails will be used. It is estimated that it will cost between $18,000 and $20,000 a mile. The line, when finished, will be nearly 300 miles long.

Big Horn Valley.—Chartered in Wyoming to build a railway from a point near Casper, Wyo., through the Big Horn Valley to the headwaters of the Cakes Fork River, in Montana. Among the incorporators are: W. W. Dudley, Richmond, Ind.; John W. Howe, St. Albans, Vt., and Carroll T. Herbert, Red Bank, N. J.

Arizona.—The approach of the date before which, according to the bill passed by the last Territorial Legislature of Arizona, all railway companies incorporated would be free from taxation on their property for 20 years, if work is begun at once, has caused a large number of new companies to be chartered. The various companies are in a too embryonic condition to be worthy of detailed mention.

FOREIGN.

Peninsular R. R. Co. of Lower California.—This company, which has been noted from time to time in these columns, has now completed its organization in England. It proposes to build a line of railway from San Diego, Cal., southeast to the Trinidad Valley, and thence southwest to San Quintin, in Lower California, a distance of 162 miles, with a branch from Ensenada, Lower California, to Yuma, Arizona. Two parties of engineers are now surveying the line. One of these is working from the north, and has located the line from San Diego to a point about 45 miles south of Tia Juana, on the International line, a total distance of a little over 50 miles. The other party is working north from San Quintin, and is now at a point near Coluntura, about 100 miles north of San Quintin. Each party consists of 16 men. The work of surveying has been very difficult. From San Quintin, north to Colnett work is now in progress under contractor R. A. Graham, of San Diego, Cal. About 16 miles have been graded, and 5 miles of track laid. It is expected to have 21 miles in operation by Jan. 1, 1892. The work is quite light, and there are few bridges of any size. The maximum grade is 106 ft. per mile, and the maximum curve is between 9° and 10°. The present company secured its concession from the Mexican Land & Colonization Co. It will receive a cash bonus of $8,000 per mile from the Mexican Government. It is intended to have the entire line completed within 18 months. W. Z. Earle, of San Diego, Cal., is Chief Engineer.

Honduras.—A press dispatch from Chicago says:

A few months ago William C. Burchard, United States Consul at Ruatan, Honduras, obtained from that country generous concessions, which, besides giving permission to construct and opecate a railway from the northwest of Honduras 250 miles inland to the capital of the republic, carried with it a land grant of nearly 3,000 acres of the best land in the republic for every mile of railway constructed. It also gives freedom from all export and import duties on all materials to be used in constructing the road, and to all colonists wishing to settle on the land. The scheme seemed so feasible that a party of Chicago capitalists, with R. L. Martin, David Courter and Horace F. White at their head bought the concession from Mr. Burchard for a large sum of money, and immediately took steps to have a company incorporated. On Sept 25 a certificate of incorporation of the Chicago & Central America Co. was returned. The new company has a capital stock of $5,000,000, all of which is pledged. A meeting of the stockholders will be called within ten days and officers elected. Mr. Courter expects to start for Honduras with a corps of surveyors within 60 days to lay out the most practicable route and make plans for the new venture. The line of the projected road is expected to run through forests of timber, such as ebony, mahogany, Spanish cedar, rubber, lignum vitæ, pines and fancy oaks, which in themselves will be a source of profit.

CITY TRANSIT.

Electric Railways.—*Nantucket, Mass.*—The Nantucket Beach Street Ry. Co. proposes to extend its lines and adopt an electric system.

New Haven, Conn.—The West Haven Horse Ry. and the Winchester Ave. Ry. have been sold to a syndicate, represented by Walter, Cook & Wagner, of New York, and will be equipped with an electric system.

Buffalo, N. Y.—The Buffalo, Kenmore & Tonawanda Electric Ry. Co. has been incorporated by L. F. W. Arend, F. M. Vilas and F. G. Sikes, with a capital stock of $150,000.

Brooklyn, N. Y.—The Coney Island & Brooklyn R. R. Co. (the Jay and Smith St. line) has applied for permission to change its motive power from horses to the trolley electric system, on the route from near the city line on 15th St. to 9th Ave. and 9th St. A hearing is being given by commissioners, and there is considerable objection.

Rochester, N. Y.—An electric road to Fairport, for freight and passenger traffic, is to be built. For particulars address Mr. L. J. Delano, of Fairport.

Baltimore, Md.—The North Baltimore Passenger Ry. Co. and the Central Ry. Co. have applied to the city council for permission to use the trolley electric system. The Baltimore Union Passenger Ry. Co., lessee of the Baltimore & Hampden Ry., has applied to the county commissioners for authority to extend the road along Roland Ave. and operate it by electricity.

Greensboro, N. C.—The Greensboro St. Ry. Co. intends to build an electric road. President, R. M. Douglas.

Akron, O.—An electric railway is to be built by A. L. Johnson to Cuyaloga Falls and Ravenna.

Wellsville, O.—An electric railway 8 miles long to East Liverpool is being built.

Columbus, O.—An electric railway to Mifflinville and Westerville is projected. For particulars address A. B. Koler, of Westerville.

Cleveland, O.—An electric railway to Richfield is projected. Mr. C. F. Brush is interested.

Sioux City, Ia.—The Riverside Co. has made a satisfactory test of a storage battery car on the system used on the Beverly & Danvers road, Beverly, Mass.

San Jose, Cal.—An electric railway is to be built to Haywards, connecting all the towns between Oakland and San Jose. Including branches the road will be 48 miles long and will cost about $500,000. Mr. Felix Chapelett has the franchise.

Horse Railways.—*Brooklyn, N. Y.*—The Brooklyn City Ry. Co. has applied for permission to build a line on Myrtle Ave. from the city line to Richmond Hill.

Elizabeth, N. J.—The Philadelphia syndicate which controls the Newark lines is said to have bought out the Elizabeth Street Ry. Co.

Charleston, S. C.—The Enterprise Ry. Co. proposes to extend its road several miles.

Pensacola, Fla.—The Pensacola Terminal Ry. Co. will extend its street railway. President, Graham Gordon, of Baltimore, Md.

Cable Railway.—***San Francisco, Cal.***—The Castro St. line is to be extended from 26th St., along Diamond St. to the San Jose road, to connect with the San Francisco & San Mateo electric railway. Construction will probably be commenced in 2 months.

Elevated Railways.—***Brooklyn, N. Y.***—The Fulton Elevated Ry. Co., is surveying for its extension of the Kings Co. Ry., about a mile. The Union Elevated Ry. Co., is preparing to build its Seaside & Brooklyn extension to Fort Hamilton.

Philadelphia, Pa.—About $3,000.000 has been subscribed toward building the Northeastern elevated road. The time specified in the ordinance of Councils for beginning work will expire Oct. 24.

Montreal, Que.—The Montreal Elevated Ry. Co. has applied for power to build a standard gage line, partly single and partly double track, on Mount Royal Ave., Park Ave., Sherbrooke and Bleury Sts. to Craig St.

BRIDGES, TUNNELS AND CANALS.

Bridges.—***Lancaster, N. H.***—An iron bridge will be built across Israel's River near this place.

Fort Meade, Fla.—Bids will be received until Oct. 9 for building a bridge across Bowlegs Creek. Address W. B. Gardner, Fort Meade.

Milwaukee, Wis.—The Chicago, Milwaukee & St. Paul R. R. Co. has agreed to subscribe $125,000 in aid of the proposed viaduct across the Menominee Valley, and it is probable that the structure will be built. It will cost about $600,000.

Duluth, Minn.—The St. Paul & Duluth R. R. Co. has promised to pay $50,000 in aid of the proposed viaduct across its tracks at this place.

HIGHWAYS.

Connecticut.—Arrangements for improvements of roads around New Britain are being made by the Selectmen. Telford paving will be laid.

Alabama.—The Board of Revenue of Montgomery Co. is giving considerable attention to the improvement and maintenance of roads, and several roads have already been improved.

Colorado.—A survey has been made by Mr. Titcomb, Deputy State Engineer, for a state wagon road 13½ miles long between Bergen Park and Florissant. The Ballarat Smuggler Mining Co. proposes to build a toll road from Ballarat to Lyons, at a cost of $10,600. The contract for building the new portion of the road on the Bear Creek route has been awarded to A. G. Breen, of Golden, at 22½ cts. per cu. yd. for rock and 12 cts. per cu. yd. for earth work.

California.—At a recent meeting of the Eureka Board of Trade the committee appointed to investigate and report on the proposition to bond the county for the building and repairing of roads in the county, made a report recommending a petition to the Board of Supervisors for an election to pass on the question of issuing bonds in the sum of $175,000 for building new roads and repairing old ones. The boulevard that is talked of in Santa Barbara will probably be from 80 to 100 ft. wide, ¾ mile long, and cost about $60,000.

WATER-WORKS.

NEW ENGLAND.

Auburn, Me.—A commission of five has been appointed by the Supreme Judicial Court to determine the price to be paid by the city for the works of the Auburn Aqueduct Co. C. W. Walton, Deering, and L. A. Emery, Ellsworth, are on the committee.

Kittery, Me.—The Norsemen Springs Resort Co. was incorporated Sept. 24 to improve real estate and build works. Benjamin T. Rowe, Boston, is President and Dustin Lancey, Newton, Mass., Secretary.

Antrim N. H.—A committee has been appointed to report on works Nov. 3.

Brattleboro, Vt.—The company talks of increasing its supply.

St. Albans, Vt.—L. A. Taylor, Boston, has recommended the building of a 145,000,000-gall. impounding reservoir above the present one at an estimated cost of $34,000.

West Albany, Vt.—M. B. Chafey is Secretary and Ira Sanders Treasurer of a newly organized water company. Proposed supply, springs, by gravity.

Cambridge, Mass.—An appropriation for $30,000 to lay 20,000 ft. of pipe has been requested.

North Brookfield, Mass.—As now proposed, the supply will be pumped from Horse Pond or Bigiow Brook to a reservoir, at an estimated cost of $100,000.

Pittsfield, Mass.—An additional supply is under consideration.

South Hadley Falls, Mass.—The contract for the new reservoir has been awarded to Daniel O'Connell, of this place, for about $15,000. Pipe will be furnished by the Jackson & Woodin Co., Berwick, Pa., for about $10,000, and valves by the Rensselaer Manufacturing Co., Troy, N. Y., for $4,500.

Stoughton, Mass.—A move toward a better water supply is being made by the town. The present works are owned by a company.

Newport, R. I.—It is reported that new reservoirs will be built.

MIDDLE.

Alfred Centre, N. Y.—The people have voted to build works.

Caledonia, N. Y.—It is reported that Mr. Hickey has offered to build works for the village for $5,000.

Ilion, N. Y.—A report will soon be submitted to the village by C. W. Knight, Rome, on gravity works.

Sandy Creek, N. Y.—The contract for gravity works has been awarded to Adam Miller, Saratoga Springs, for about $16,000, and construction has been started. There will be a reservoir and about 5 miles of mains.

Suspension Bridge, N. Y.—C. B. Gaskill has offered to buy the village works.

Walton, N. Y.—The company has recently decided to build a new reservoir.

Westport, N. Y.—It is reported that R. H. Rogers, Plattsburg, has secured the contract for building works at $25,000. There will be 5 miles of mains and construction will be started Oct. 6. The Westport Mountain Spring Co. was incorporated Sept. 30 by Thomas Lee, Alice Lee and F. T. De Lano, Westport, and Almon A. Stout, Portland, Me.; capital stock, $20,000.

Yorkshire Centre, N. Y.—The company has begun construction of the new gravity works.

Bogata, N. J.—The Bogata Water & Light Co. has been incorporated to furnish fire protection in mills and to supply light and heat; capital stock, $5,000, of which $2,000 is paid in. A. G. Munn, Jr., H. MacDougall and others are the incorporators.

Jersey City, N. J.—There is considerable agitation for a new water supply.

Duncannon, Pa.—The Duncannon Water Co. was incorporated Sept. 24; capital stock, $25,000.

Wayne, Pa.—The contract for a 1,500,000-gall. reservoir has been awarded to Henry Birkinbine, Philadelphia.

SOUTHERN.

Wheeling, W. Va.—We are informed that the Council has instructed the Finance Committee to report whether funds can be raised for new pumps. Also that the agitation for a new water supply still continues.

Carrollton, Ga.—The Senate has passed a bill authorizing an election to vote on the issuance of water bonds.

Richland, Ga.—A bill permitting the establishing of works has passed the Senate.

Greenville, Tenn.—Address H. R. Brown, Secretary Water-Works Committee, concerning bids for works.

Harrodsburg, Ky.—A majority of 136 have voted in favor of works.

NORTH CENTRAL.

Cincinnati, O.—The Committee on Water-Works will investigate and report upon the inadequacy of the works and remedies for the same.

Ithaca, O.—It is reported that this place will soon have works.

Tiffin, O.—It is reported that a new system will be built.

Elk Rapids, Mich.—The Elk Rapids Water Supply Co. was incorporated Sept. 12; capital stock, $30,000.

Buchanan, Mich.—The first election having been illegal a second one has been held, resulting in a vote of 282 to 18 for $50,000 of bonds for works.

Emden, Ill.—C. H. Scholz is advocating the building of works.

Hartsburg, Ill.—Works have been completed.

Springfield, Ill.—Bids are wanted until Oct. 10 for furnishing and laying about 16,000 ft. of 24-in. cast-iron pipe. Address R. D. Lawrence, Mayor.

NORTHWESTERN

Auburn, Neb.—An attempt to secure works is being made.

Blue Springs, Neb.—The Council has awarded a contract for a stand-pipe system of works to Shepard & Co., Beatrice, for $8,600, payable in city bonds at par.

Deadwood, S. Dak.—The supply furnished by the company is said to be bad. A committee has been appointed by the Council to confer with the company, and, in case no satisfaction is obtained, to investigate the possibility of a supply from another source.

SOUTHWESTERN.

Aurora, Mo.—It is reported that J. Guinney has stated that he will build works at once.

Comanche, Tex.—Works are wanted.

Dallas, Tex.—The Council has voted to accept the bid of the Holly Manufacturing Co., Lockport, N.Y., for a 10,000,000-gall. triple expansion pump; price, $67,000.

Elgin, Tex.—An experimental well will be sunk with a view to building works.

Gatesville, Tex.—It is reported that works are to be built.

Gonzales, Tex.—It is reported that the Gonzales Water-Works Co. has sold their works for $20,000, and that new mains and machinery will be put in.

Jacksonville, Tex.—Works are talked of.

Quanah, Tex.—Works are still projected.

Brighton, Col.—The people have voted for works. It is proposed to have them in operation by Jan. 1.

Colfax, Col.—The Citizens' Water Co. will lay 15,740 ft. of 4 and 4,720 of 6-in. mains, and set 35 hydrants within 4 months.

PACIFIC.

Port Townsend, Wash.—The Mount Olympus Water Co. has offered to sell its works to the city for $62,000. It is stated that the offer will probably be accepted.

Spokane, Wash.—A. R. Junken and F. W. Harrington have submitted to the City Commissioners a scheme for a gravity supply from the Spokane River.

Gilroy, Cal.—The Coyote Water Co., it is reported, wishes to supply the city with water. The city owns the present works.

Stockton, Cal.—A street sprinkling and fire protection system is being built by the city.

Brigham City, Utah.—An effort to secure works is being made.

ARTESIAN WELLS.

Hillsboro, Tex.—Artesian well bonds to the amount of $7,000 will be issued by the city. They will bear 6% interest and run 15 years.

Memphis and Midland, Tex.—A well is wanted at each place.

IRRIGATION.

Wyoming.—The Green River Canal Co. is making surveys for a 20-mile canal to take water from the Green River about 60 miles from the Union Pacific station of the same name. Estimated cost, $750,000.

Moffatt, Col.—T. C. Henry has offered to put water on 10,000 acres of State land between Moffatt and Garrison, by extending one of his Rio Grande River ditches. In return he wishes to secure a title to each alternate section of land for $2.50 per acre. The matter is before the State Land Board.

Ellensburg, Wash.—The Middle Irrigation District will vote on the issuance of $200,000 of bonds for the construction of a ditch 50 miles long, 12 ft. wide at bottom and 18 at the top.

Yuma, Ariz.—Two canals are to be built below Yuma. E. M. Sanford is interested.

New Company.—East Fork Irrigating Canal Co., Hood River, Ore.; $7,000.

SEWERAGE AND MUNICIPAL.

Sewers.—***Massachusetts.***—Quincy. The vote on the proposed sewer act has resulted in defeat. It was proposed to appoint a Board of Sewer Commissioners to undertake the establishment of a complete system of sewers. —Lynn. The outfall sewer, designed by Mr. Rudolph Hering, is to be completed.—Amesbury. Action on the sewerage question has been postponed. The cost was estimated at $75,000 to $90,000.—Fitchburg. The U. S. Filtering & Sewage Co. is putting up its building.

Connecticut.—Meriden. The sewerage plan has been adopted by public vote. It is not likely that work can be begun before July next. The charter provides that the city's indebtedness shall not exceed 5% of its grand list, which is now $530,000. The outstanding indebtedness, when the new water-works are completed, will be $380,000, which with the present outstanding $80,000 of city improvements, leaves only $70,000 available for the sewer work. This sum may be increased to $100,000 in July, when $30,000 of the outstanding bonds will be paid off. —Upper Ansonia. A report on a plan for sewerage will be made by Mr. Shedd, City Engineer of Providence, R. I.

New York.—Lansingburg. An appropriation of $68,000 has been made for crosstown sewers.

Pennsylvania.—Williamsport. A bill has been passed appropriating $25,000 for house and storm water sewers.

Virginia.—Manchester. Plans and specifications for a sewerage system have been prepared by Col. Waring, and it is proposed to issue bonds for $75,000 for the work.

Georgia.—Brunswick. Proposals will be received soon for the construction of a sewerage system.

Ohio.—Cleveland. The old question of an intercepting sewer is being again discussed. A report upon the project was made by Mr. Rudolph Hering, of Philadelphia, some years ago. The cost is estimated at $400,000.—Lorain. A sewer system is projected.

Indiana.—New Albany. Sewers are to be provided for in the tax levy.

Illinois.—Petersburg. The contract for the sewerage system has been awarded to J. W. Price, of Jacksonville.

Iowa.—Des Moines. An ordinance has been passed for establishing sewers in North Des Moines.

Washington.—Fairhaven. The Council Committee on Sewers has been directed to advertise for bids for the construction of the sewers authorized in August.

Manitoba.—Winnipeg. Mr. Ruttan, the city engineer, has recommended the construction of as many brick sewers as possible before cold weather; so that the work on the pipe sewers can go on during the winter.

Streets.—***Rhode Island.***—Pawtucket. The Highway Department is doing considerable work in street improvement.

New Jersey.—Asbury Park. The Board of Trade is in favor of street improvement, using either gravel or macadam. Mr. Zacharias, of the Asbury Park Wheelmen, gave an approximate estimate of the cost under the several propositions for building streets as follows: A, gravel, $1.25 per load, delivered, spreading and rolling included;

B, macadam 6 ins. deep; C, Trinidad asphalt, $3 per sq. yd.

	A.	B.	C.
Cost of each 50 × 50 ft. of road	$85.00	$217.83	$831.00
Cost to each lot, 50 × 25	42.50	158.91	415.50
One-third cost to lot	28.33	72.61	277.00

Pennsylvania.—Norristown. The Norristown & Bridgeport Street Ry. Co. will lay hard red brick paving between its tracks.——Philadelphia. Mr. Windrim, Director of Public Works, proposes that contractors for street work shall guarantee their work for 15 years.

North Carolina.—Salisbury. A contract has been let for macadamizing the streets.

Iowa.—Dubuque. Brick paving is to be laid. The city engineer, Mr. Blake, considers Dubuque brick too soft and prefers Galesburg brick in two courses on sand and broken stone foundation.

Garbage Disposal.—***Washington, D. C.***—The only proposal for garbage removal received by the District Commissioners was from R. V. Lusk, at $34,200, but as the balance of the appropriation only amounted to $18,000 the bid was thrown out and no change will be made until Congress meets. In the mean time the health officer has been directed to prepare full and complete specifications. Proposals will be invited upon these with the understanding that the contract will be subject to an appropropriation from Congress.

Bonds.—Portland, Ore.: $55,000 for water-works, $45,000 for sewers, $30,000 for municipal building. Los Angeles, Cal.: $120,000 for court house, bids asked by the Board of Supervisors. Orlando, Fla.: for municipal improvements. Pontiac, Mich.: $14,000 for electric light. Elberton, Ga.: $40,000 for water-works and electric lights.

ELECTRICAL.

Electric Light.—***Lawrence, Mass.***—A contract has been made with the electric light company at $4,500 per annum for 3 years, all night schedule.

Haverhill, Mass.—The street lighting committee is in favor of a municipal electric plant.

Philadelphia, Pa.—The electrical committee has reported negatively upon a request to the finance committee to appropriate $150,000 for the purchase of the Germantown electric light plant.

Towson, Md.—An electric light company of South Bend, Ind., is investigating relative to the establishment of an electric light plant.

Moberly, Mo.—An electric light plant is to be put in this fall at a cost of $50,000.

Modesto, Cal.—The electric light company bid for 27 lights in the middle of the streets $5.50 and $7.50 per light per month for the moonlight and all night schedules, respectively.

Anacortes, Wash.—Mr. J. C. Otis, city engineer, writes that the city has granted to the Skagit Mill Co., composed of H. Clothier, E. G. English and J. F. McCann, a franchise for 25 years, for an electric light and power plant. The city takes 15 arc lights, of 2,000 c. p., for five years at $12 per light per month; additional lights, $12 up to 50; $11 over 50. Maximum prices to private consumers are as follows:

C. P.	Midnight.	All night.
10	$ .90	$1.25
16	1.50	2.00
24	2.00	2.25
32	2.75	3.25

The steam plant in use at the company's saw mill will be used for power. Poles are now being made. The plant is to be in operation by Dec. 4.

Companies.—Sharon Telephone Co., of Ogdensburg, N. Y.; Geo. O. R. Bell, John Hannan and J. E. Lum; $15,000. Portsmouth Electric Light & Power Co., of Newport News, Va.: E. C. Hillyer, T. H. Gordon and W. W. Archibald; $100,000. Fredonia Electric Light, Heat & Power Co., of Fredonia, N. Y.; Geo. Barker, L. McKinstry and F. R. Green; $30,000. Thomson-Houston Electric Light & Power Co., of Sharon, Pa.; treasurer, Edward G. Waters, Pittsburg; $30,000. Electric Construction Co., of Roanoke, Va.; H. W. Sellers, C. A. Pearson and R. J. Byron, of Philadelphia, Pa.; $300,000. Gray Electric Co., of Chicago, Ill.; electrical supplies; Elisha Gray, F. W. Cushing and L. O. McPherson; $100,000; Pittsburg Underground Electric Construction Co., of Pittsburg, Pa.; C. D. Robbins, D. J. Rex and J. J. Miller; $300,000. Nicholson Electric Hoist Co., of Cleveland, O.; Martyn Bonnell, Ezra Nicholson and E. C. Pope; $30,000. Bogota Water & Light Co., of Bogota, N. J.; A. G. Munn, Robert Dyatt and Geo. Foster; $5,000.

CONTRACTING.

Dredging.—The following proposals for dredging in the Penobscot River between Bangor and Crosby Narrows have been received by Lt.-Col. J. A. Smith, U. S. Engineer Office, Portland, Me.: A. K. Stone, Boston, Mass., 26¼ cts. per cu. yd.; R. Hamilton, Chebeague, Me., 26¾ cts.; National Dredging Co., Wilmington, Del., 43 cts.; Moore & Wright, Portland, Me., 45 cts.; Thomas Symonds, Leominster, Mass., 48 cts.; A. B. Martin, Boston, Mass., 50 cts.

Bridge Masonry.—***Niagara Falls, N. Y.***—The following proposals have been received by W. C. Johnson for about 150 cu. yds. of abutment masonry for the enlargement of the Third St. bridge. The face will be range work, not less than 8 ins. thick, and rubble backing. Bids per cu. yd. The contract was awarded to John Sandstrom.

	Removing earth. cts.	Rock. $	Mason work. $
William Shepard	35	1.25	9.63
Alexander Mason	40	1.35	9.18
R. D. Young	75	2.00	8.50
John Sandstrom	75	2.50	6.50
C. H. McDonald	..	....	7.80

Street Work.—***Pottsville, Pa.***—The contract for paving Center St. has been awarded to Lewis Grant, of Pottsville, at $2.96 per sq. yd. for Cape Ann Granite. Mr. M. P. Walker, Chairman of the Borough Committee on Roads and Highways, says that this is only the start of a system of paving.

Denver, Col.—The Board of Public Works has awarded a contract for Trinidad sheet asphalt paving to W. H. James, at $2.85 per sq. yd.; and to D. G. Hirchbaum for granite curbing at $1.88 and $3 per ft. for straight and circular.

Materials for Concrete.—The following proposals for materials for concrete, delivered at Fort Monroe, Va., and Fort Washington, Md., have been received by Col. P. C. Hains, U. S. Engineer Office, Washington, D. C.:

	Broken Stone. Fort Monroe. Per cu. yd.	Broken Stone. Fort Wash'gton. Per cu. yd.
Calvin Tompkins, New York, N. Y.	$2.08¼	$2.29
J. S. Howell, New York, N. Y.:		
Bluestone	2.30	2.50
Granite	2.40	2.60
Trap	2.70	2.90
G. W. Gray, Georgetown, D. C.	2.30	....
Montague & Tyler, Richmond, Va.	2.19	....
C. G. Smith & Son, Washington, D. C.	2.68	1.77¼
W. H. Mobler, Washington, D. C.	....	2.00
Geo. L. Neville, Portsmouth, Va.	2.49	....
	Cement	
Geo. L. Neville, Portsmouth, Va.	$1.75	$1.80
J. H. McGill, Washington, D. C.	1.14	1.14
N. Y. & Rosendale Cement Co., New York	1.15	1.15
C. C. McColgan Co., Baltimore, Md.	1.25	1.25
	1.30	1.34
	1.35	1.40
F. O. Norton, New York, N. Y.	1.14	1.17
	Sand	
G. W. Gray, Georgetown, D. C.	$....	$0.79
J. T. Summers, Washington, D. C.	....	0.80
	Pebbles	
G. W. Gray, Georgetown, D. C	$....	$1.49
J. T. Summers, Washington, D. C.	....	1.30

Brick.—***Wilmington, Del.***—The Street and Sewer Department has received the following proposals for fire brick: George H. McCall Co., New Cumberland brick, $18.58 per 1,000; New Brighton, $21.50; Toronto, $18.58. Charles Warner Co., Minor's brick, $18.45. W. F. Robinson & Co., West Pennsylvania brick, $22.50; Glide brick, $18.75. New England Steam Brick Co., Barrington brick, $14.

PROPOSALS OPEN.

Pipe.—***Springfield, Ill.***—Furnishing and laying 16,000 ft. of 24 in. cast iron water pipe and special castings. R. D. Lawrence, Mayor. Oct. 10.

Track.—Railway track, transfer ship, car and caisson on the James River, about 5 miles from Richmond. Col. Wm. P. Craighill, U. S. Engineer Office, Richmond, Va. Oct. 15.

Granite.—Furnishing and placing riprap granite and raising 300 ft. of sea-wall at Fort Adams, R. I. Major R. Livermore, U. S. Engineer Office, Newport, R. I. Oct. 19.

World's Fair.—***Chicago, Ill.***—Labor and material for completing Machinery Hall and Annex, Oct. 7. About 450,000 sq. ft. of walks, in 10,000-ft. contracts; width, about 40 ft.; brick, stone, tile, wood, cement, concrete, asphalt, etc. Oct. 20. D. H. Burnham, Chief of Construction, Rookery Building.

Sewers.—***Roanoke, Va.***—Brick intercepting sewer, 2,000 ft. long. G. L. Bennett, City Clerk. Oct. 20.

Ogden, Utah.—Sewer 5 blocks long. T. P. Bryan, City Recorder. Oct. 15.

Street Work.—***Houston, Tex.***—Grading, paving, curb walls and gutters; gravel, brick, asphalt or bois d'arc block paving. City Secretary. Oct. 26.

MANUFACTURING AND TECHNICAL.

Locomotives.—The Rhode Island Locomotive Works, of Providence, R. I., have an order for 6 passenger engines and 2 switch engines for the Chicago & West Michigan. The Baldwin Locomotive Works, of Providence, R. I., have delivered 2 passenger engines and 1 switch engine to the Northeastern, of South Carolina. The Columbus, Hocking Valley & Toledo will add 5 moguls and 2 switch engines to its equipment. The Cincinnati, Hamilton & Dayton has put 2 ten-wheel passenger engines on its Cincinnati and Indianapolis express service, on account of the heavy grades ot that division.

Cars.—The Haskell & Barker Car Co., of Detroit, Mich., is building 500 box cars for the Lake Erie & Western. The Madison Car Co., of Madison, Ill., is building 300 furniture cars, 40 ft. long, 60,000 lbs. capacity, for the Madison Belt road; 1,000 box cars, 34 ft. long, 60,000 lbs. capacity, for the Chicago, Burlington & Quincy; 500 box cars of the same size for the Savannah, Florida & Western, and 25 barrel cars for the Standard Oil Co. The Peninsular Car Co. and the Michigan Car Co., both of Detroit, Mich., are each building 250 box cars for the Burlington, Cedar Rapids & Northern. A new ventilated refrigerator car has been built at the shops of the Mobile & Ohio, Whistler Ala., to the designs of Mr. Carson, Superintendent of Machinery and Mr. Gurganus, Master Car Builder, who are the patentees. A number of these cars are to be built. The Randall Street & Electric Car Mfg. Co., of Kittery, Me., has been organized by I. H. Randall, of Boston, Mass., and W. Y. Miller, of Chestnut Hill, Mass.; capital stock, $50,000.

Crane.—A foundry crane of 6 to 10 tons capacity will be wanted for the new foundry of the Brass & Iron Works Co., Fostoria, O.

The National Water Purifying Co. reports sales of 2 large filter plants in this country, each over 2,000,000 galls. capacity, also a large gravity filter plant for a water-works in the United States of Colombia.

The Berlin Iron Bridge Co., of East Berlin, Conn., recently shipped 23 carloads of iron building material by a special train over the N. Y., N. H. & H. R. R. to New York for shipment to Rio de Janeiro, Brazil. This is said to be one of the largest single shipments that ever passed through New England, the total weight being nearly 1,000,000 lbs. This building is for a car works for the Companhia Nacional de Fojas e Estaleiros, and the tools and machinery for the entire equipment will also be supplied from this country.

Boilers.—The Narragansett Electric Lighting Co.'s station, at Providence, R. I., which was visited by the members of the American Society of Mechanical Engineers during its recent meeting at Providence, has been equipped with Babcock & Wilcox boilers of 1,120 HP. The *Boston Journal of Commerce* states that the drums of the Moore sectional boilers, which were recently placed in the station, are to be changed to the Babcock & Wilcox system.

Stand-pipe.—Tippett & Wood, of Phillipsburg, N. J., have shipped the material for a large water tower to be erected at Portland, Ore. Last year they erected one at Tacoma, Wash. The tower at Portland will be a duplicate of the one just completed for the Plainfield, N. J., Water Supply Co. The firm has been very successful with it standpipes, and will soon complete the hundredth of its erection in this country. All the stand-pipes built by it are still standing, without the record of a break or collapse against them.

Companies.—Morgan Construction Co., of Worcester, Mass., to build manufacturing plants, etc.; C. H. Morgan and Paul B. Morgan, $10,000. Lindsley Terminal Equipment Co., of Chicago, Ill., railway supplies and equipment; P. S. Grosscup, F. L. Wear and H. R. Pebbles, $100,000. Martin Car Coupler Co., of Chicago, Ill.; A. C. Martin, F. J. Barber and J. M. Corrigan, $1,000,000. Brown & Henderson Improvement Co., of Camden, Ark; President, J. B. Brown, $50,000. Central Construction and Equipment Co., of Chicago, Ill.; R. Shinn, J. R. Parker and T. Hall, $200,000. Columbian Lavatory Co., of Chicago, Ill., to operate public lavatories; J. Speyer, Chas. Cavanah and Chas. Young; $400,000. Fall River Steam & Gas Pipe Co., of Fall River, Mass.; L. W. Sumner and Wm. H. Goodwin, $7,500. Van Dorston Cushioned Carrier Iron & Railway Supply Co., of Alexandria, Va.; $500,000. Security Corporation, of Newark, N. J.; J. P. Waterbury, New York; E. L. Mekirgan, of Summit, N. J.; $350,000. American Mfg. Co., of Elizabeth, N. J., electrical and mechanical apparatus; S. D. Hillman, New York, N. Y.; A. D. Phillips, Plainfield, N. J.; C. W. Leveridge, Brooklyn, N. Y.; $100,000.

Metal Market Prices.—***Rails.***—New York: $30.75 to $31; old rails, $22 for iron and $16.50 to $17 for steel; girder rails, $40. Pittsburg: $30; old rails, $24 for iron and $17 to $18 for steel. Chicago: $31.50 to $33; light and street rails, $32.50 to $35; old rails, $23 for iron and $14 to $16 for steel.

Track Materials.—New York: steel angle bars, 1.75 to 1.8 cts.; spikes, 2.25 cts.; track bolts, 2.8 to 3 cts., with square and hexagon nuts. Pittsburg: splice bars, 1.75 to 1.85 cts. for iron or steel; iron or steel spikes, 2.1 to 2.15 cts.; iron track bolts, 2.75 cts. with square and 2.85 with hexagon nuts. Chicago: splice bars, 1.85 cts. for iron, 2 cts. for steel; spikes, 2.2 to 2.25 cts.; track bolts, 2.75 to 2.8 cts. with hexagon nuts.

Foundry Pig Iron.—New York: $14 to $18. Pittsburg: $14.50 to $17. Chicago: $14 to $16

Pipe.—Cast iron, $20 to $30 per ton. Wrought iron, discounts as follows, at Pittsburg: 52½ and 42½ per cent. on black and galvanized butt-welded; 62½ and 50 per cent. on black and galvanized lap-welded. Casing, 55 per cent.

Lead.—New York: 4.52 to 4.57 cts. Chicago: 4.3 to 4.35 cts. St. Louis: 4.3 to 4.35 cts.

Structural Material.—New York: beams, 3.1 cts.; channels, 3.1 cts.; angles, 1.9 to 2.1 cts.; tees, 2.45 to 2.75 cts.; sheared iron plates, 1.95 to 2.25 cts.; steel plates, 1.95 to 2.15 cts. for tank, 2.2 to 2.3 cts. for shell, 2.45 to 2.65 cts. for flange, 3 to 3.25 cts. for firebox. Pittsburg: beams, 3.1 cts.; channels, 3.1 cts.; angles, 2 cts.; tees, 2.6 cts.; universal iron mill plates, 2 to 2.05 cts.; sheared steel bridge plates, 2.15 to 2.2 cts.; refined bars, 1.8 to 1.85 cts.; steel plates, 2.05 to 2.1 cts. for tank, 2.15 cts. for shell, 2.4 to 2.55 cts. for flange, 3.9 to 4.25 cts. for firebox. Chicago: beams, 3.2 cts.; channels, 3.2 cts.; angles, 2.05 to 2.1 cts.; tees, 2.6 to 2.7 cts.; universal plates, 2.15 to 2.2 cts.; sheared steel plates, 2.2 to 2.25 cts. for steel; steel plates, 2.4 to 2.6 cts. for tank, 2.75 to 3 cts. for shell, 3 to 3.5 cts. for flange; 5.5 cts. for firebox; boiler rivets, 4.25 cts.